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June 1953

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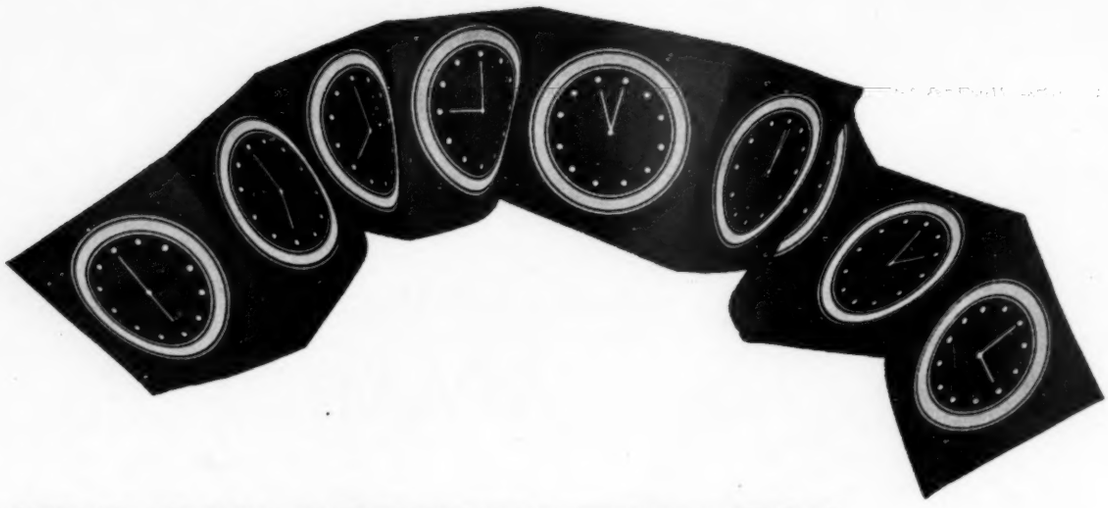

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*Bonica, J. J.: J.A.M.A., 150:1581, Dec. 20, 1952.

The American Journal of Surgery

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MEDICOLEGAL IMPLICATIONS OF PARALYSIS OF THE RECURRENT LARYNGEAL NERVE . . . *Donald E. Ross* 729

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ELECTROLYTE SOLUTIONS

SOLUTION	mEq per 1000 cc.								Carbohydrate	Route of Admin.
	Na	K	Ca	Cl	Lactate	NH_4	Mg	HPO_4		
Modified Duodenal Solution	80.0	36.0	4.6	63.0	60.0	—	2.8	—	—	Any
Travert 10%-Electrolyte No. 1	80.0	36.0	4.6	63.0	60.0	—	2.8	—	Travert 10%	Any
Travert 10%-Electrolyte No. 2	57.0	25.0	—	50.0	25.0	—	6.0	12.5	Travert 10%	Any
Travert 10%-Electrolyte No. 3	63.0	17.5	—	150.5	—	70.0	—	—	Travert 10%	Any
Ammonium Chloride 2.14%	—	—	—	400.0	—	400.0	—	—	—	IV
Darrow's	121.0	35.0	—	103.0	53.0	—	—	—	—	Any
M/6 Sodium r-Lactate	167.0	—	—	—	167.0	—	—	—	—	Any
Travert 10%-Potassium Chloride 0.3% in Water	—	40.0	—	40.0	—	—	—	—	Travert 10%	Any
Travert 10%-Potassium Chloride 0.3% in 0.45% NaCl	77.0	40.0	—	117.0	—	—	—	—	Travert 10%	Any

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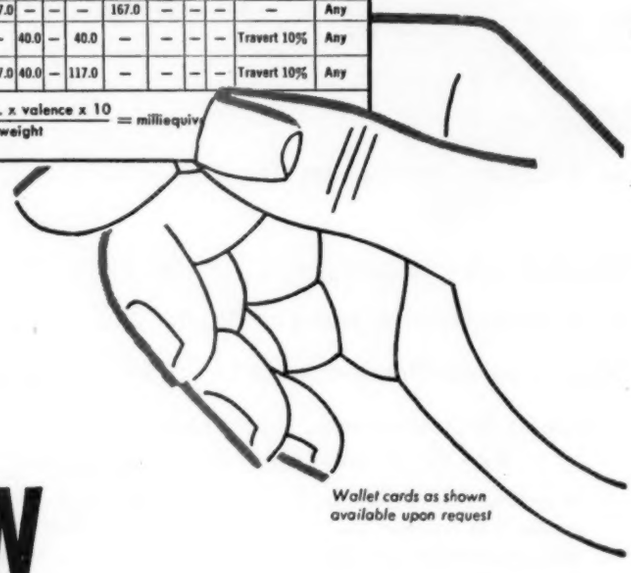

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The American Journal of Surgery

Reg. U. S. Pat. Off., Nov. 3, 1936

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EPIDERMOID CYST OF THE TERMINAL PHALANX OF A FINGER, WITH A REVIEW OF THE LITERATURE . . . . . *Isadore Zadek and Herbert G. Cohen* 771

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Fig. 1: "Roentgen examination . . . revealed the ulcer to be very much in evidence."

Fig. 2: In ten weeks "the ulcer niche was no longer in evidence roentgenologically or gastroscopically."

Clinical Evaluation of Pro-Banthine*

CASE REPORT

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FOCAL DEGENERATION OF THE PATELLAR TENDON . . . . . *Henry Milch* 804

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POSTERIOR MEDIASTINAL GOITER. USE OF COMBINED THORACOCERVICAL APPROACH FOR EXCISION . . . . . *William C. von der Lieth and Charles W. Lester* 811

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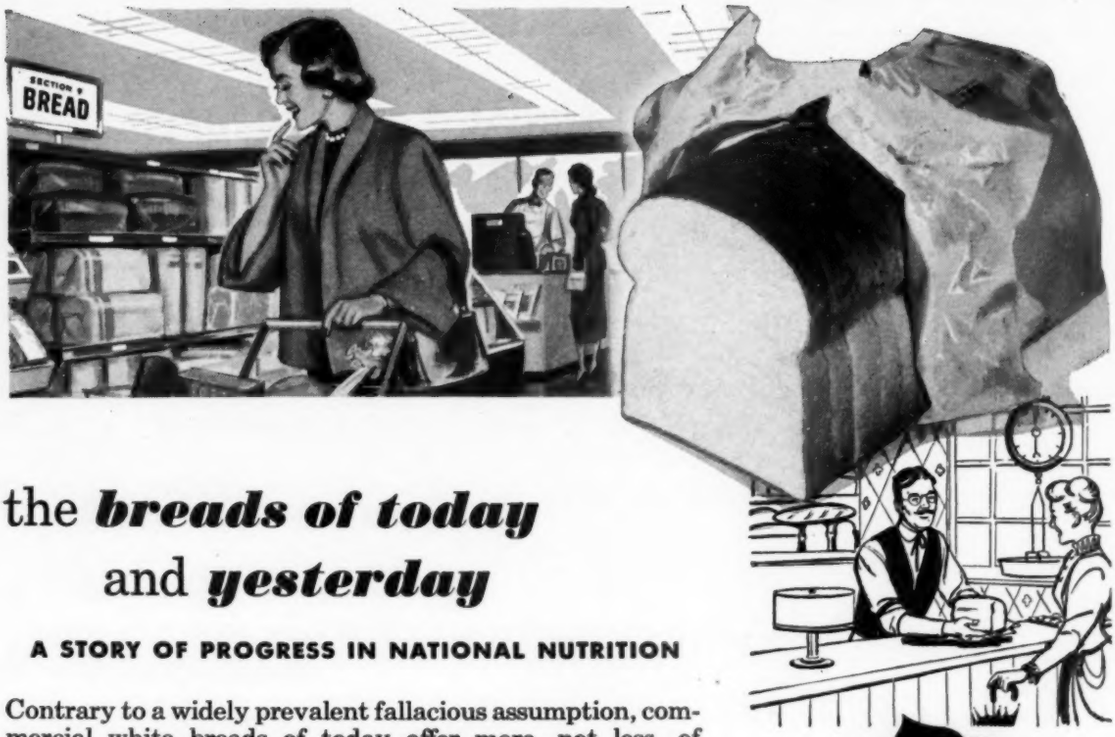

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1. Flour and Bread Enrichment, 1949-50: Prepared by The Committee on Cereals, Food and Nutrition Board, National Research Council, Washington, D.C., 1950.

2. Geddes, W.F.: Cereal Chemists Guard Nutrition, Agricultural and Food Chemistry *1*:38 (Apr.) 1953.

3. Bakery Products; Definitions and Standards of Identity, Federal Register *17*:4453 (May 15) 1952.

4. Sherman, H.C.: Chemistry of Food and Nutrition, ed. 8, New York, the Macmillan Company, 1952, p. 599.

5. Goddard, V.R., and Marshall, M.W.: The Calcium Content of Commercial White Bread, United States Department of Agriculture, Technical Bull. No. 1055, 1952.

Crespo, S., and Bradley, W.B.: Calcium and Milk Content of Commercial White Bread. Report by the Laboratories of the American Institute of Baking, Feb. 28, 1950.

The Seal of Acceptance denotes that the nutritional statements made in this advertisement are acceptable to the Council on Foods and Nutrition of the American Medical Association.

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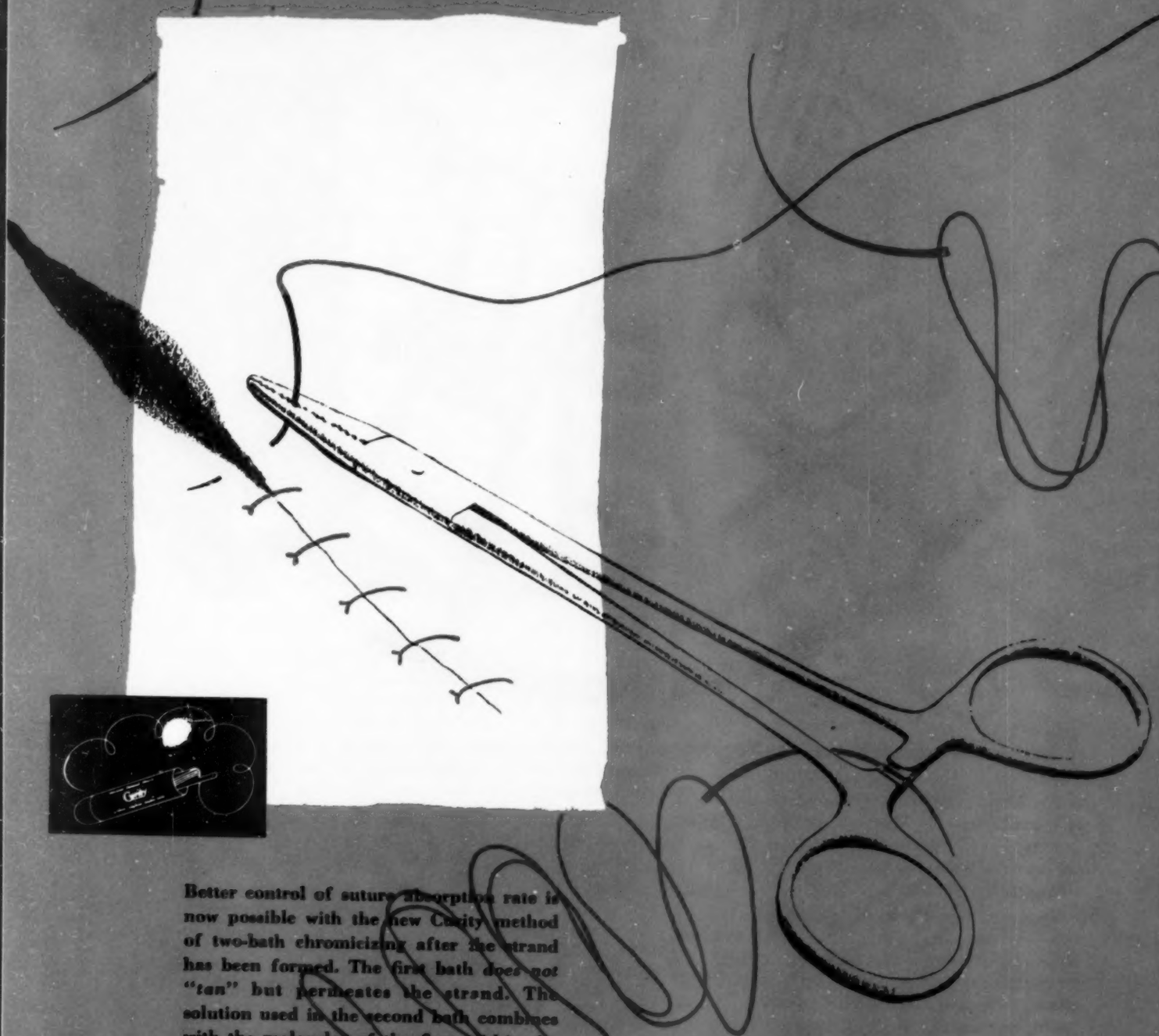

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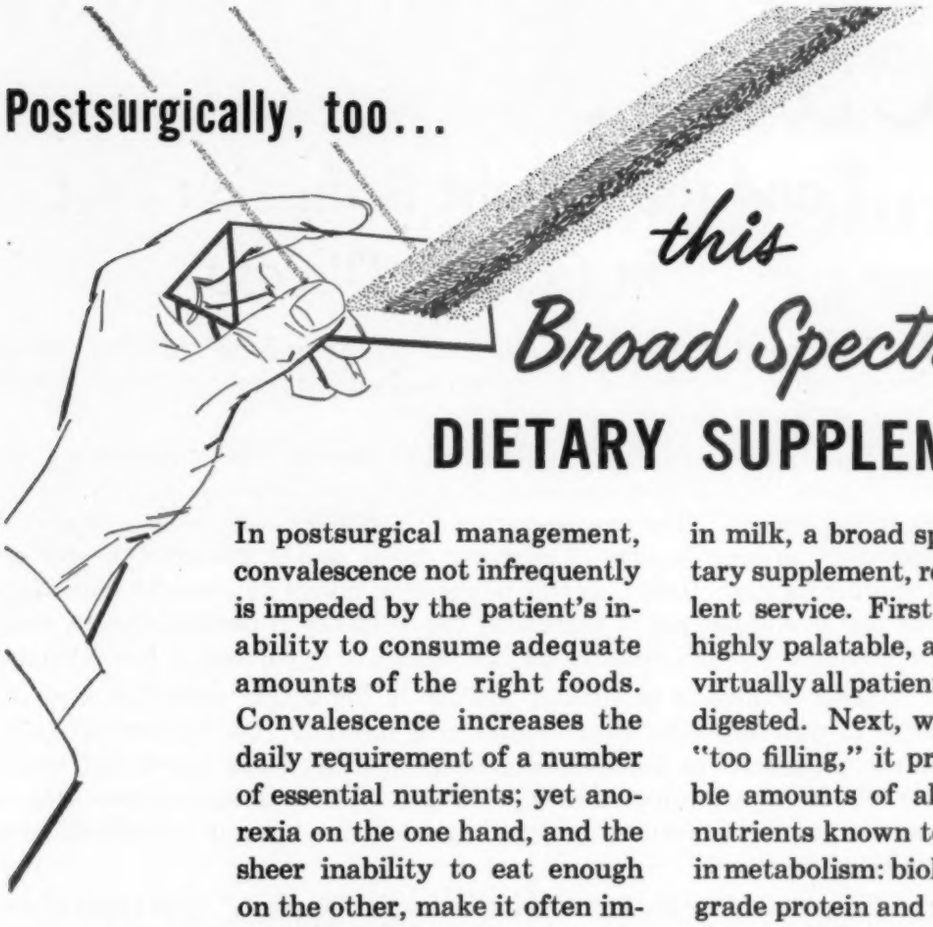

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*IRON	12 mg.	PYRIDOXINE	0.6 mg.
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For reasons not entirely understood at present, "heart disease and high blood pressure are more common in overweight persons than in those of desirable weight." The predisposition to atherosclerosis in obesity and the increased physical burden of carrying excess weight are undoubtedly contributing factors. Hence, as this publication points out, weight reduction is the first line of defense in decreasing the incidence of cardiac disease, and in improving the prognosis after cardiac disease or hypertension has developed.

Meat occupies a prominent position in the weight reduction diets outlined in this American Heart Association booklet. This recommendation is in sharp contrast to the erroneous belief held in former years that meat is harmful in hypertension or cardiac disease. "There is no evidence that red meat or any other form of protein in moderation has any adverse influence on blood pressure."

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—

*Food For Your Heart, a Manual for Patient and Physician, Department of Nutrition, Harvard School of Public Health, Harvard University, The American Heart Association, Inc., New York, 1952. Copies available through local Heart Association.

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1. Bowers, W. F.: Am. J. Surg. *73*:37, 1947.
2. Pollock, L. J., and others: J. A. M. A. *146*:1551 (Aug. 25) 1951.
3. Niemiro, B. J.: Journal Lancet *71*:364, 1951.
4. Lowry, K. F.: Postgrad. Med. *11*:523, 1952.
5. Combes, F. C.; Zuckerman, R., and Kern, A. B.: New York State J. Med. *52*:1025, 1952.

Literature containing comprehensive information on the uses of chlorophyll in medicine will be forwarded on request. Reprints of recent papers are also available.

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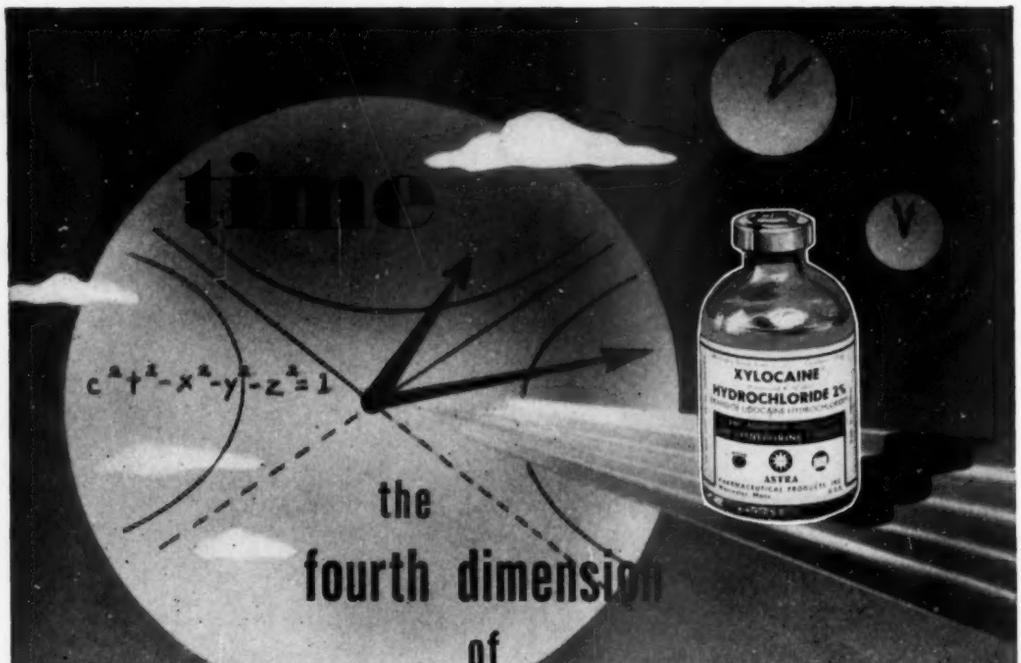

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Thiamine HCl (B_1)	10.0	mg.
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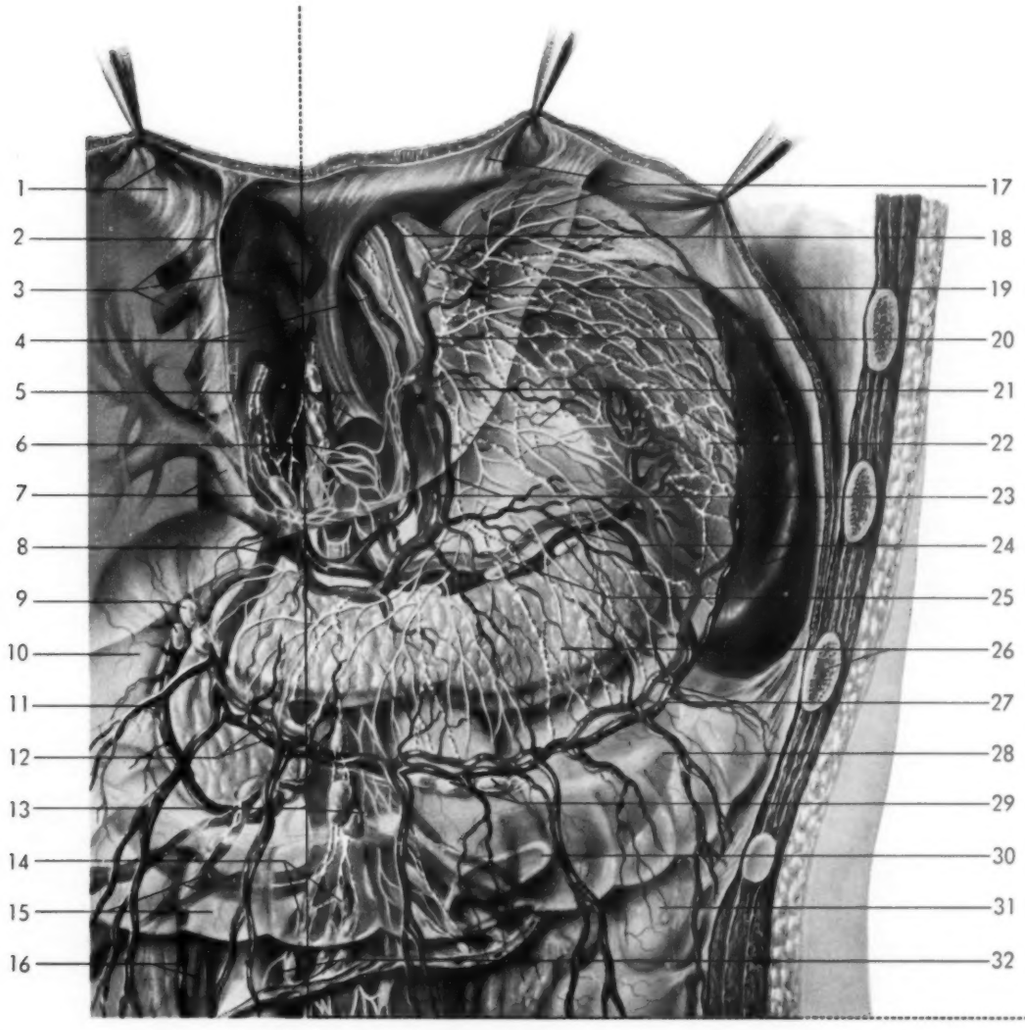
Upper Left Quadrant of the Abdomen



1 Diaphragm and coronary ligament
2 Falciform ligament
3 Hepatic veins
4 Inferior vena cava and right vagus nerve
5 Crus of diaphragm and abdominal aorta
6 Celiac artery and celiac plexus
7 Hepatic artery and portal vein
8 Gastroduodenal artery and vein
9 Subpyloric lymph nodes
10 Duodenum
11 Superior pancreaticoduodenal artery and vein
12 Right gastroepiploic artery and vein
13 Superior mesenteric artery and vein
14 Superior mesenteric lymph nodes
15 Transverse colon and right colic artery and vein
16 Spermatic artery and vein
17 Left triangular ligament and left lobe of liver
18 Esophagus and left vagus nerve
19 Paracardial lymph nodes
20 Esophageal branch of left gastric artery and vein
21 Gastric rami of vagus nerve
22 Splenic lymph nodes
23 Left gastric artery and coronary vein
24 Spleen and splenic artery and vein
25 Superior pancreatic lymph nodes
26 Pancreas and tenth rib
27 Left gastroepiploic artery and vein
28 Left kidney
29 Inferior gastric lymph nodes
30 Jejunum
31 Descending colon
32 Ileocolic artery and vein

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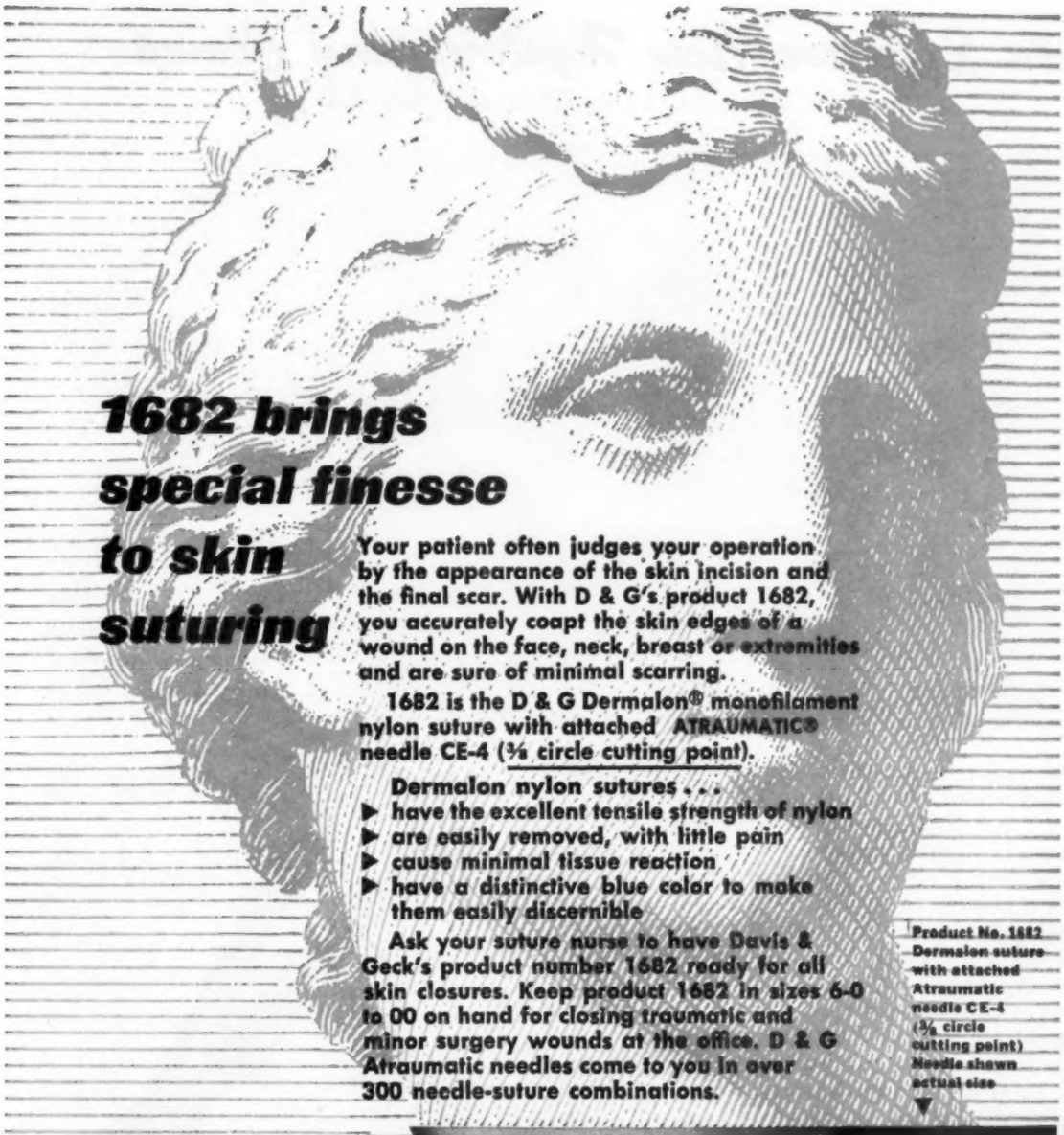

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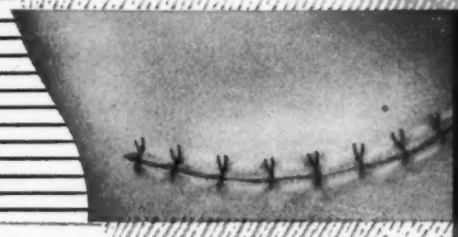

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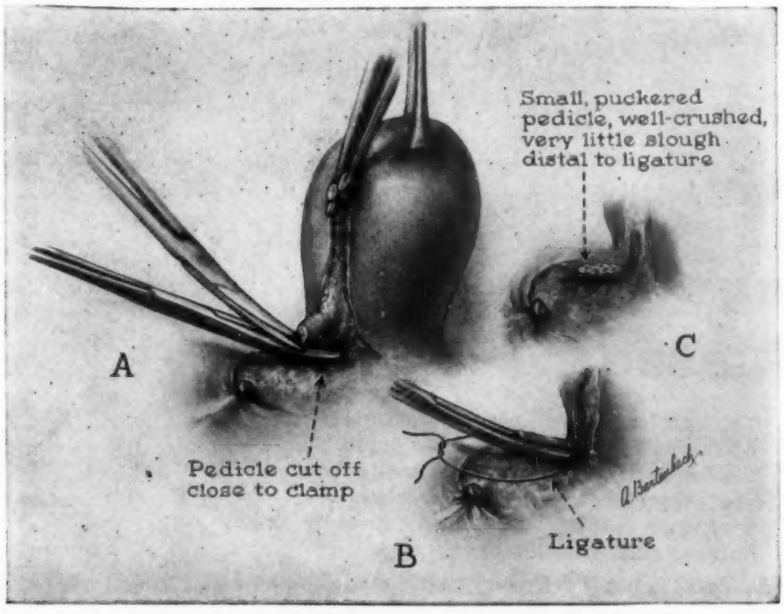

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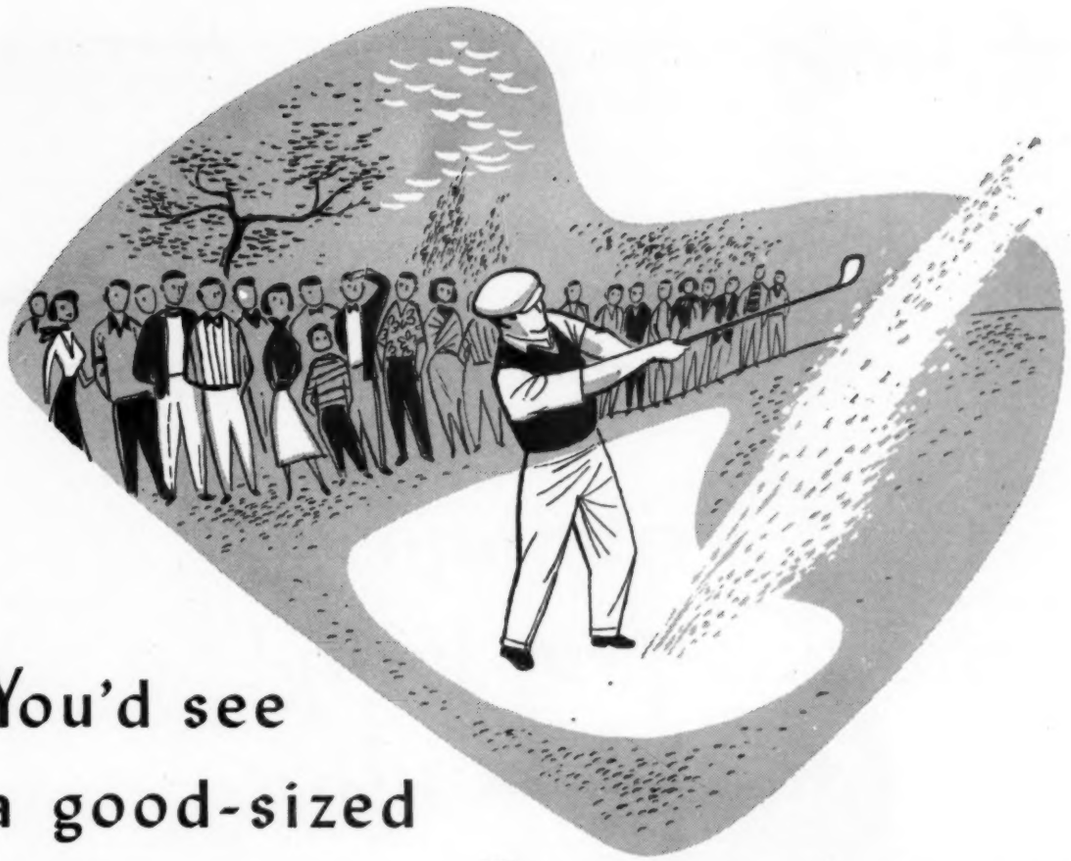

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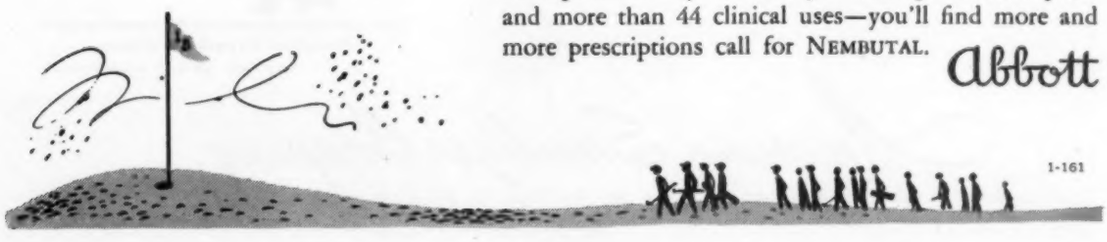

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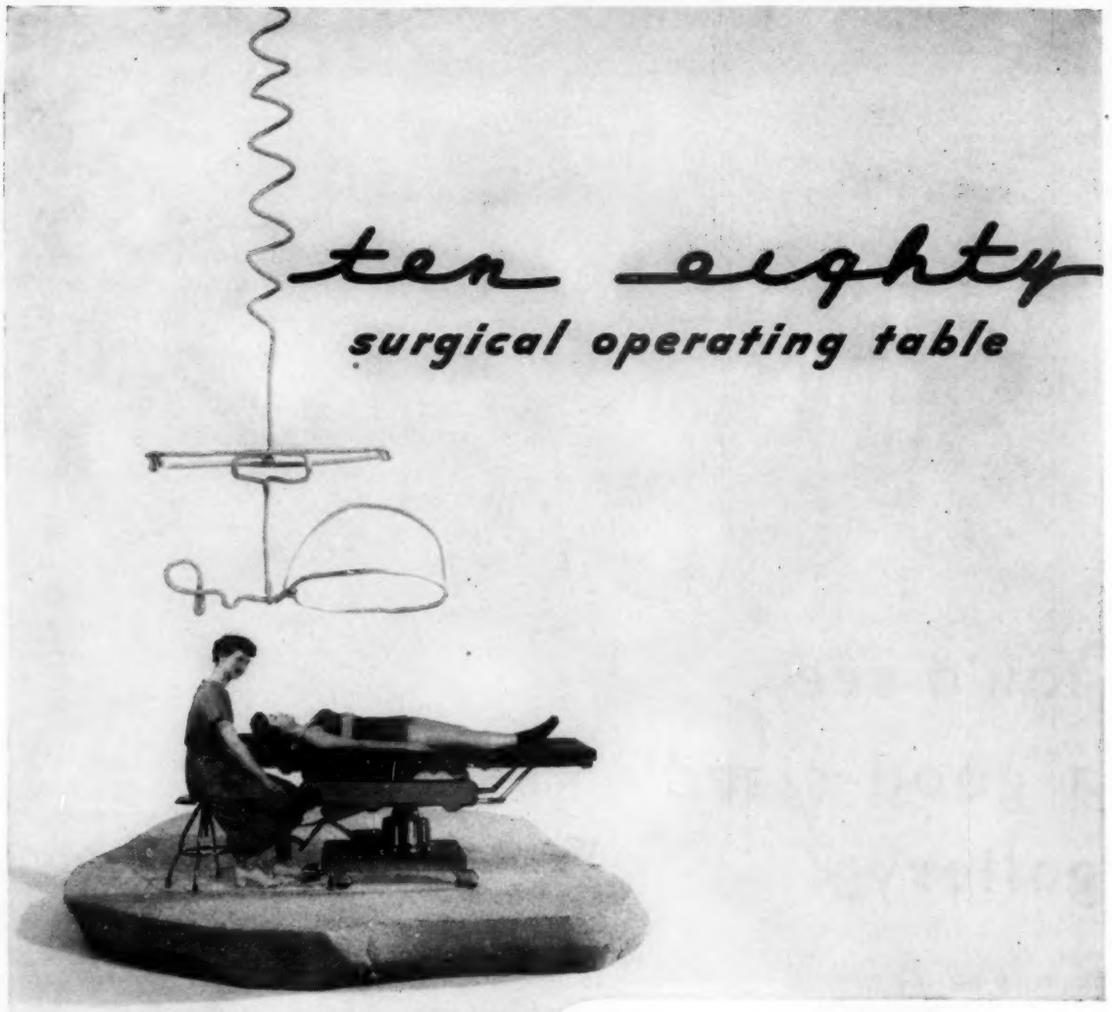

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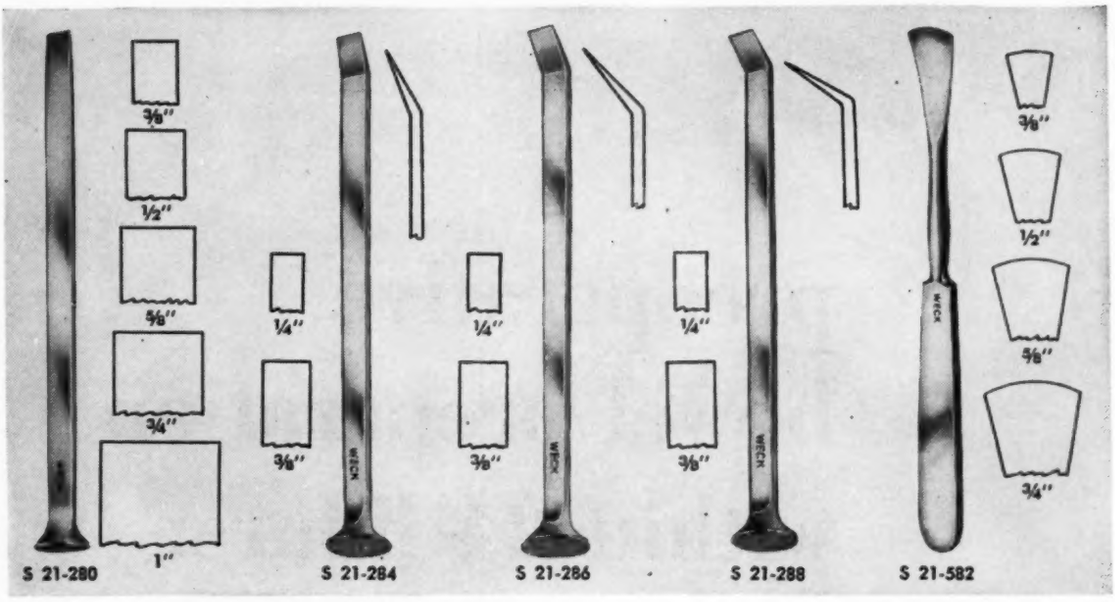

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""Use of the Pelviscope in Culdotomy", J. A. M. A., Feb. 21, 1953, Vol. 151, No. 8.*

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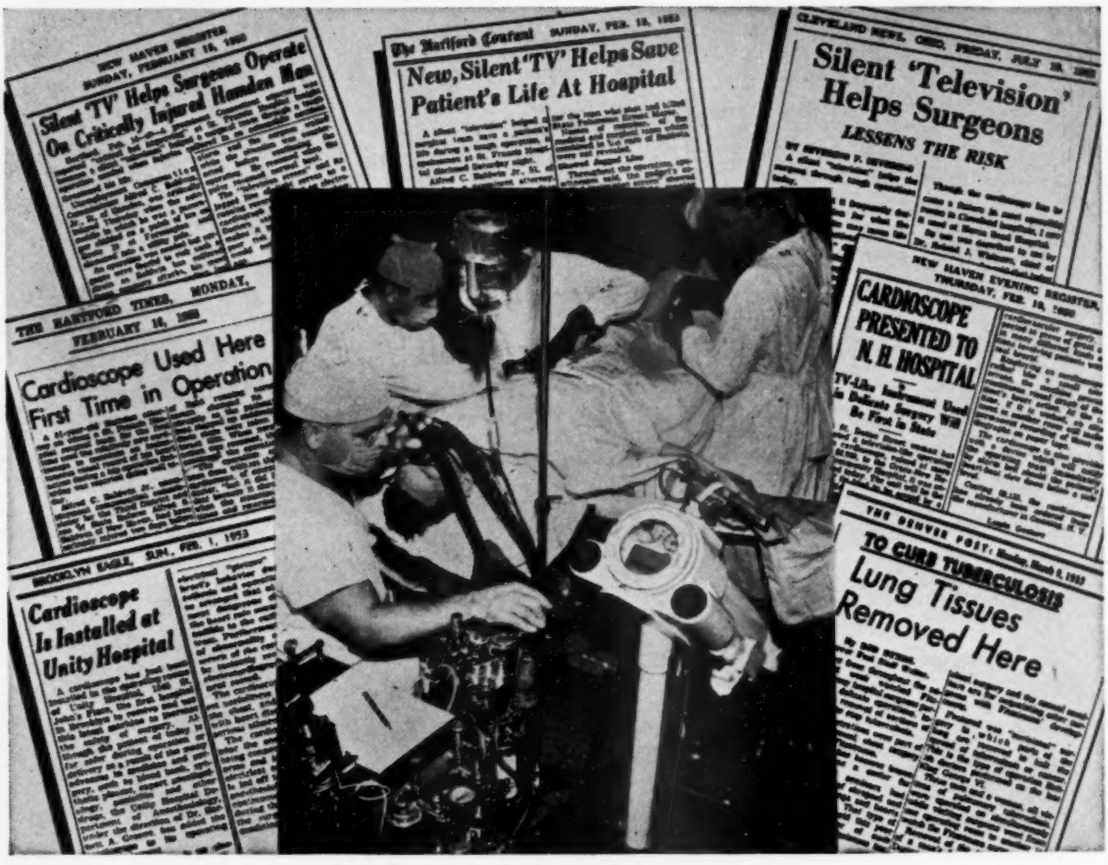
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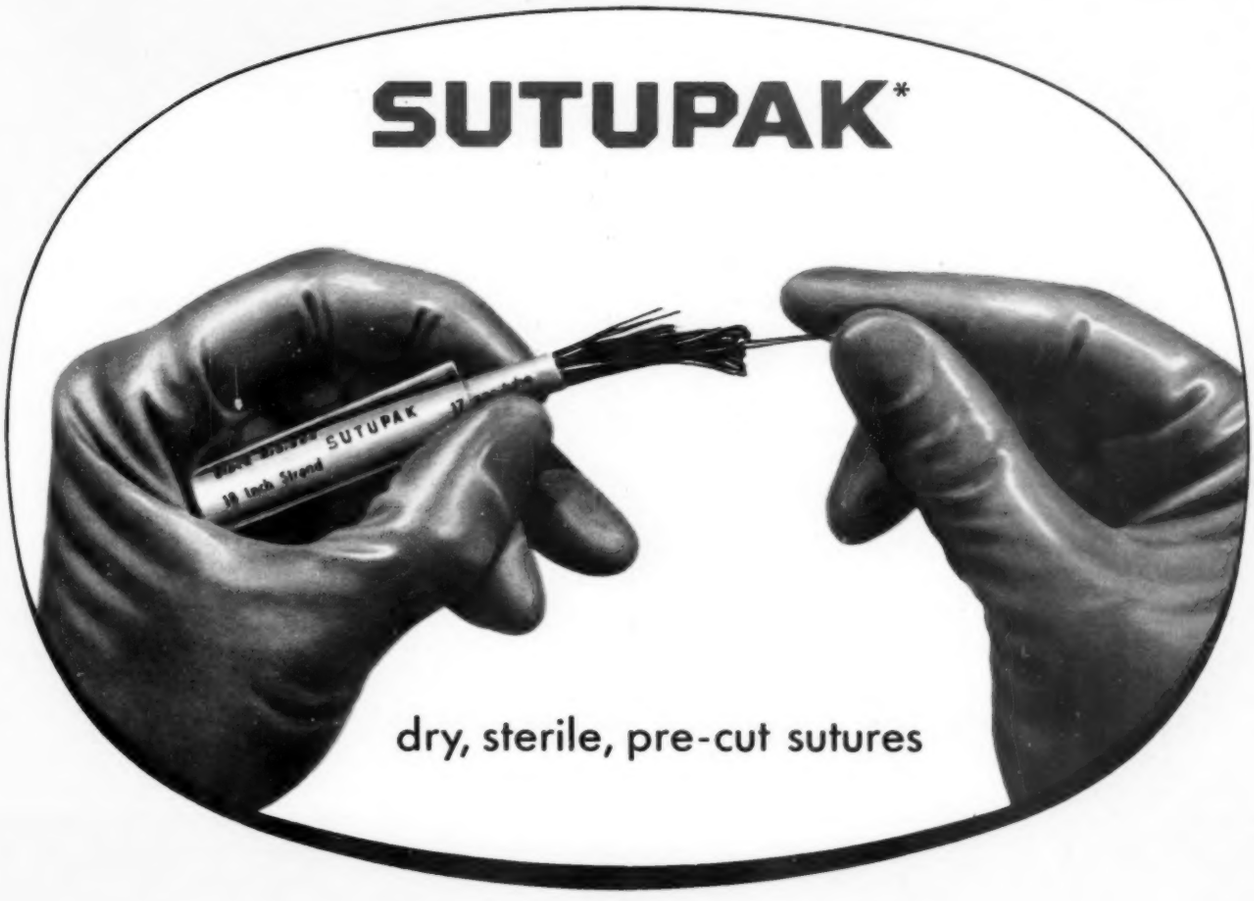

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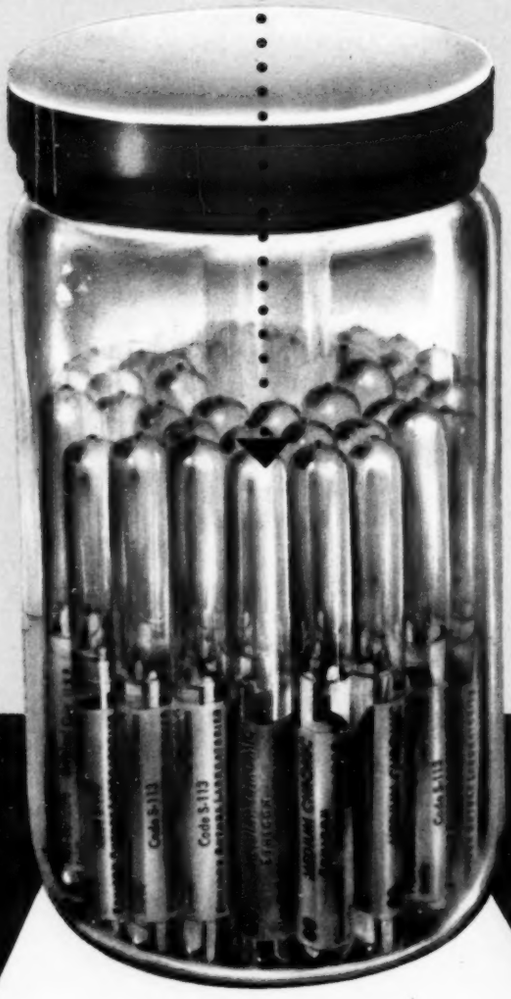

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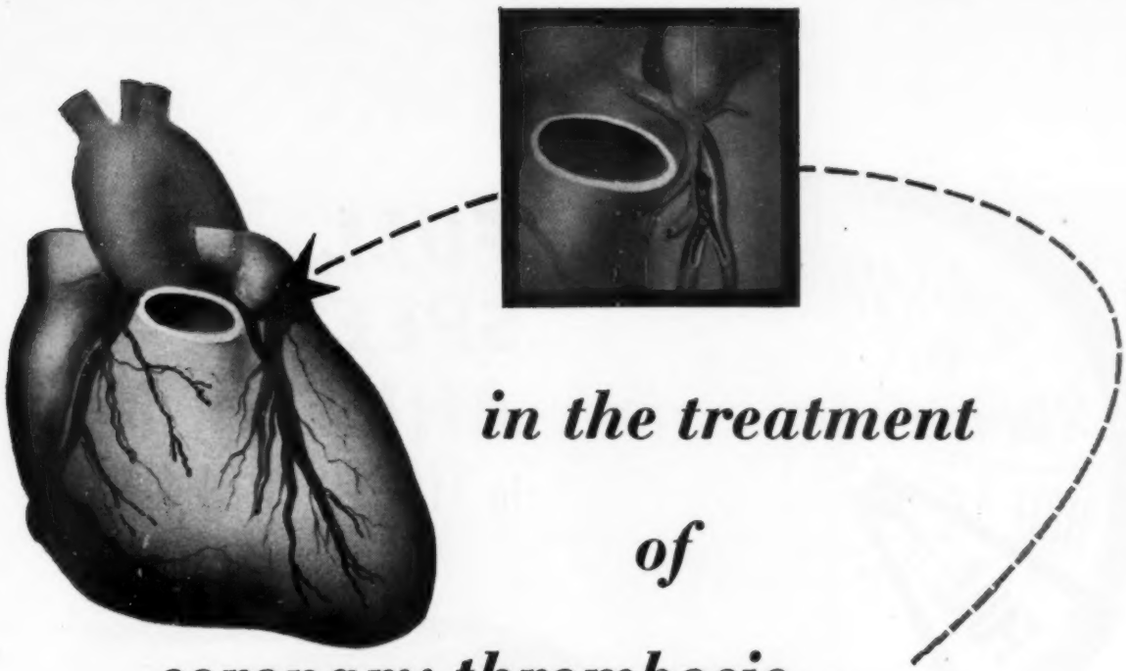

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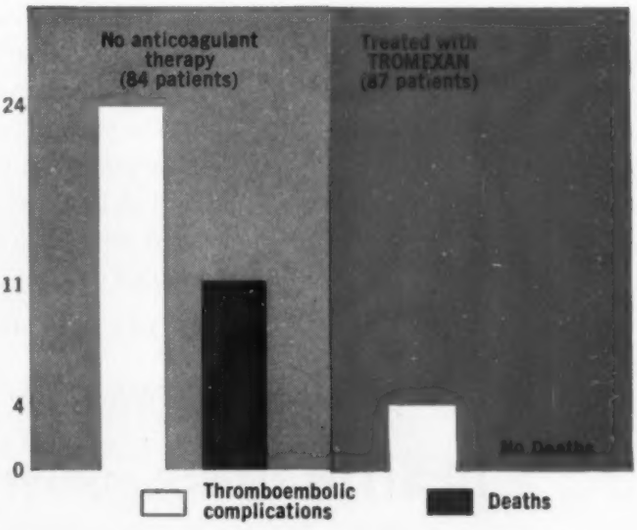

1. Tulloch, J. A., and Gilchrist, A. R.: Tromexan in the Treatment of Coronary Thrombosis, Am. Heart J. *42*:864, 1951.

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1. Behrman, H. T., Combes, F. C., Bobroff, A., Leviticus, R.: Ind. Med. & Surg. 18:512, 1949.
2. Turell, R.: New York St. J. M. 50:2282, 1950.
3. Heimer, C. B., Grayzel, H. G., and Kramer, B.: Archives Pediat. 68:382, 1951.

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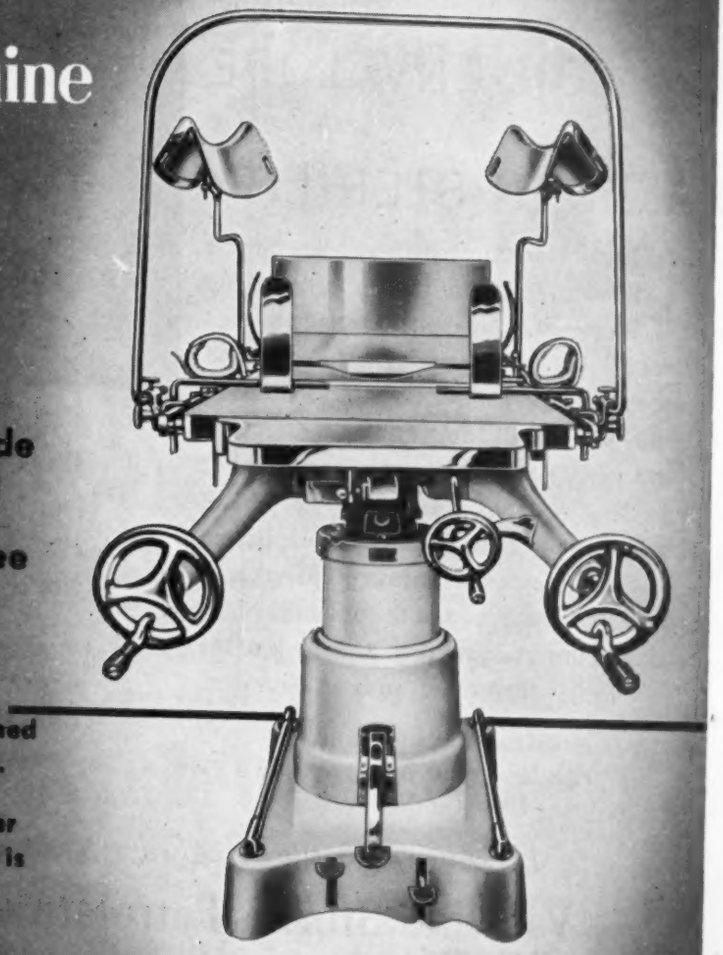

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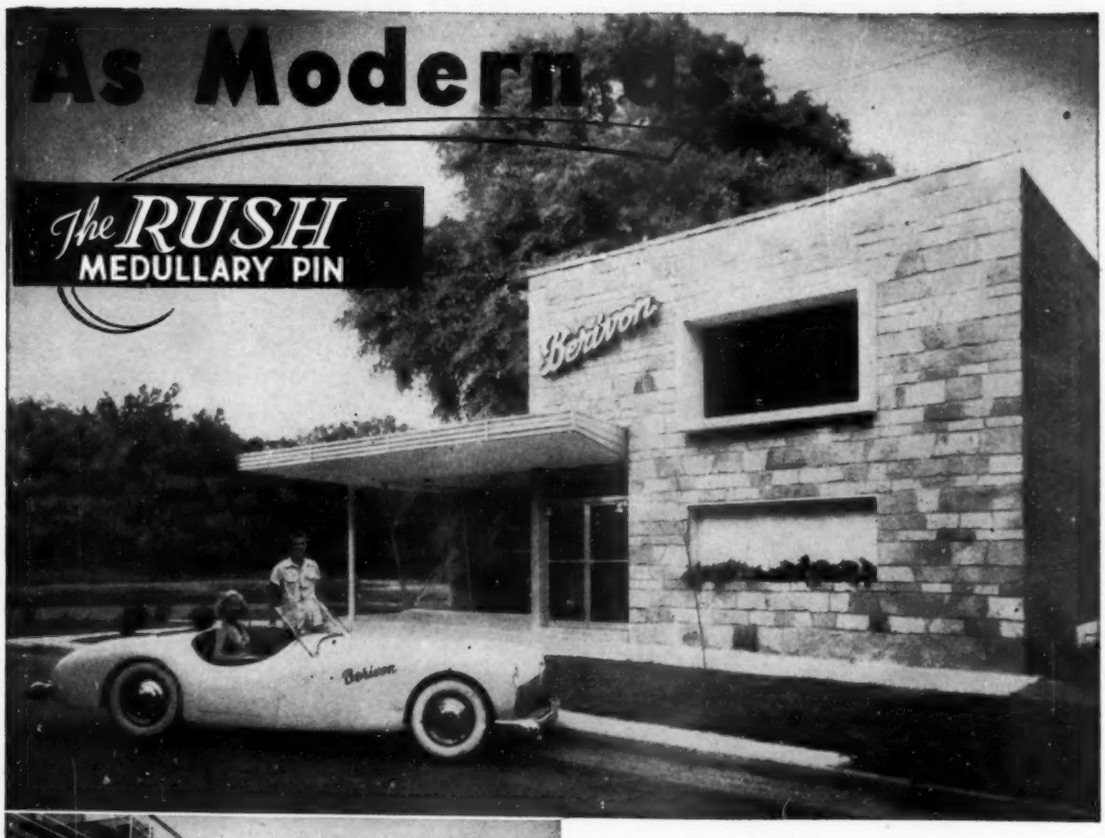

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Editorial

THE BLEEDING CERVICAL STUMP

THE number of patients who bleed from a retained cervix after subtotal hysterectomy seems to be increasing each year, doubtless because of the great number of hysterectomies that are performed. The controversy concerning subtotal versus total hysterectomy has existed for a great many years. Admittedly, supracervical or supravaginal hysterectomy is a simpler operation to perform and is attended by fewer complications than is the total operation, also known as panhysterectomy.

The protagonists of the subtotal operation have argued that total ablation of the uterus shows a higher mortality than does carcinoma of the retained cervical stump. This may have been true fifty to twenty-five years ago, but it does not apply at the present time. With the marked improvement in anesthesia and surgical technic, the well planned pre- and postoperative care, early ambulation, blood transfusions, fluid balance, the antibiotics and sulfonamides, etc., the mortality of panhysterectomy has been brought to a very low figure.

The bleeding cervical stump may be the result of polyps, endometriosis, cervicitis and endocervicitis, cervical myomas and carcinoma. The prolapsed cervix, by friction, may also be responsible for the staining of blood. It is agreed by practically all observers that carcinoma of the stump, which appears shortly after supracervical hysterectomy, was present at the time of intervention and its presence could probably have been demonstrated by careful investigation before the operation was performed.

The modern woman has been educated to realize that bleeding after the menopause and bleeding from a retained cervical stump may be due to carcinoma, and most of the women who present themselves for examination are fearful that this disease may be present. The greatest prophylactic measure against carcinoma of the cervical stump is the excision of the cervix with the uterus when performing hysterectomy for benign disease of that organ.

An accepted form of treatment for the bleeding cervical stump, the result of benign lesions, is its excision. This may be accomplished by the vaginal route if the cervix comes down under traction and by the performance of a Schuchardt incision to increase the amount of room in the vagina as necessary. In the few cases in which the cervix does not come down readily, it is removed by the abdominal route, starting the operation on one side or the other of the cervix. In the presence of malignant disease in its early stages in the cervical stump the cervix is removed vaginally or abdominally as the case may be, and this is followed by irradiation with radium and high voltage x-ray. On the other hand, if the disease has progressed to a point where the parametria are involved and the cervix is immovable, irradiation alone is resorted to. In reality, removal of the cervical stump is more of an operation than was the original supravaginal hysterectomy

because the bladder is very adherent to the stump which it covers. In most instances, with care, the bladder may be detached from the retained cervix without injury. However, it is the second time that the bladder is separated from its attachments; the blood supply of that viscus may have been interfered with to a certain extent, and a vesicovaginal fistula may result from the sloughing of a small area of the bladder deprived of its blood supply.

The performance of the total hysterectomy will prevent these later complications and it is a proven fact that it is far simpler to remove the cervix at the time of the original operation than it is some months or years later.

LOUIS E. PHANEUF, M.D.

Original Articles

USE OF DEXTRAN (MACRODEX) IN BURNS

I. REVIEW OF THE PHYSIOLOGY OF DEXTRAN

EDWARD V. JOHNSTON, M.D.* AND JOHN S. LUNDY, M.D.†

Rochester, Minnesota

THE search for plasma volume expanders has been long and somewhat discouraging. Various macromolecular substances have been proposed in the past, only to be found not entirely satisfactory for clinical use. Inability of the body to metabolize or excrete these substances has been the chief objection, but some were antigenic or depressed the hemopoietic functions.

The need for such colloidal solutions has not decreased in spite of the widespread use of whole blood and human plasma. Blood can be stored for limited periods at present although substances are being investigated that may increase the storage period of blood. Blood must be refrigerated but should not be chilled to 32°F. or hemolysis occurs. Pooled human plasma keeps well in the dried state but is expensive to produce commercially. Neither blood nor plasma can be subjected to sterilization by heat. The risk of transmission of infective agents in pooled plasma, albeit low, has limited its routine use in the postoperative patient.

Investigators have sought a macromolecular solution of a colloidal osmotic pressure similar to that of plasma which would be safe to administer in large amounts, easily sterilized by heat, stable under varying conditions of storage and cheaply produced in large quantities. Among the many possible uses for such a product, the principal one would be its administration in cases of secondary shock unassociated with marked loss of blood. Severely burned or injured patients could receive immediate intravenous administration of such a solution on arrival at any treatment center without the delay necessary for determination of blood group or fear of complicating infectious hepatitis. Adequate stockpiling of such plasma volume expanders would be of extreme importance in the prompt treatment of large numbers of civilian casualties in the event of atomic warfare.

Dextran was introduced as a plasma substitute‡ by Grönwall and Ingelman in 1944.[12,13] Originally discovered in the nineteenth century by the German sugar chemist, Scheibler, dextran was known as a contaminant of beet sugar solutions when the latter became infected with the organism, Leuconostoc mesenteroides.[16] Dextran has been described as a water-soluble, high-molecular polysaccharide composed of glucose units jointed into long chains. The 1 to 6 linkage of these units is unusual, however, and may account for its excretion and metabolic characteristics.[6]

Raw dextran has an average molecular weight of several million but it is made up of many different-sized molecules. By means of acid hydrolysis, the molecular weight can be reduced to a figure approximating that of serum albumin. Early modifications of dextran led to the development of a 6 per cent solution of the polysaccharide, with molecular weights ranging between 30,000 and 150,000, a colloidal osmotic pressure and viscosity near that of human plasma, and a saline content of 0.9 per cent.[3]

Initial animal experimentation revealed dextran to be non-antigenic and non-toxic. In Swedish hospitals administration to patients in terminal stages of malignant disease demon-

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‡ We prefer the term "plasma volume expander" to "plasma substitute."

strated its efficacy and lack of toxicity in man.[3] The literature now contains many reports on the results of physiologic and clinical investigation of dextran. One of us (J. S. L.) received a supply of Swedish dextran in 1945 and has reported on its use in a large group of surgical patients at the Mayo Clinic.[8,18,19]

COLLOIDAL (OSMOTIC) EFFECT

The importance of the osmotic pressure of plasma as a factor in the interchange of fluid and electrolytes within the body is well known. If capillary permeability is normal, maintenance or restoration of a normal osmotic pressure aids in prevention of further loss of fluid from the circulating volume. Injury to a part of the body, such as burn of an extremity, results in locally increased capillary permeability and increased loss of fluid into the interstitial space. Passage of larger molecules, chiefly albumin, also occurs at the site, favoring a generalized lowering of the concentration of plasma protein. Immediate intravenous replacement of colloidal substances minimizes the formation of edema and its subsequent interference with gaseous and metabolic exchanges as well as with repair of the wound.

Dextran's osmotic effect is due to the presence of its large molecules in the blood stream. Some diffusion into the interstitial space is known to occur in the region of burns; Rosenqvist and Thorsén were able to measure the concentration of dextran in fluid taken from blebs. Bollman, Knutson and Lundy have recently shown that dextran, as a volemic substance (a substance dealing with blood volume),[4] diffuses into the interstitial space rather rapidly, even in the absence of demonstrable capillary damage. Measurable amounts of dextran do, nevertheless, remain within the blood stream after the initial decrease in levels due to excretion or diffusion of the smaller molecules.

The effect of dextran on osmotic pressure can be seen in patients receiving this substance, in whom the concentration of plasma proteins has fallen as low as 2.0 to 2.5 gm. per 100 cc. without the development of edema.[28] Wallenius has reported reduction of edema and increased urinary output in nephrotic patients after repeated administration of dextran.

The reduction in concentration of plasma proteins as a result of the infusion of dextran is probably brought about by a mechanism which seeks to prevent the development of colloidal osmotic hypertension.[22] The osmotic pressure of the plasma tends to remain constant owing to an equilibrium effected between the concentration of proteins and the concentration of dextran in the plasma.[28] Excessively large amounts of dextran will increase the osmotic pressure to a point greater than normal only temporarily, and the excess of dextran rapidly disappears from the circulation.

PLASMA VOLUME

Several workers have carried out studies on the results of administration of dextran to animals depleted of 30 to 50 per cent of their blood volume by bleeding. Bull and co-workers[7] bled rabbits of half their blood volume, Thorsén[25] bled ten dogs of 30 to 40 per cent, and Bollman and co-workers bled rabbits of 40 per cent of their blood volume. All reported excellent response to the replacement of the blood by similar amounts of dextran.

Turner and co-workers measured the plasma volume in seven patients who received dextran, and found at the end of twenty-four hours that the average volume was increased by 370 cc. Using tagged erythrocytes, Meyers and co-workers found an increase in blood volume varying from 960 to 2,850 cc., averaging 1,880 cc., after administration of 500 cc. of dextran. After twenty-two hours the average increase was 220 cc. over the initial blood volume of these patients.

Bloom[1] used cardiac catheterization to study the effects of dextran on the circulation. Cardiac output was increased approximately 20 per cent after injection of 500 cc. of dextran. Plasma volume was increased some 10 to 15 per cent after administration of 500 cc., and 15 to 20 per cent after administration of 1,000 cc. of dextran, as indicated by the hematocrit readings, values for plasma proteins and results of dye studies.

Experimental administration of extremely large quantities of dextran did not give rise to definitely unfavorable effects in experimental animals according to Thorsén,[28] but did produce edema. Overloading the circulating or plasma volume can occur as with any intravenously administered fluid, especially in the elderly patient.

EFFECT UPON SERUM PROTEINS

As noted previously, administration of dextran causes lowering of the concentration of plasma protein. This decrease was at first attributed to the effects of hemodilution alone but it is now generally accepted that there is an active supplanting of the plasma proteins, the albumin fraction in particular.[22] The values for protein gradually return to normal as the dextran disappears from the blood stream.

No delayed healing of wounds, no formation of edema and no disturbances in coagulation mechanisms have been noted in the patients with dextran-induced hypoproteinemia. Experiments on the tensile strength of surgical wounds in rabbits were carried on by Thorsén[26] with the conclusion that lowered concentrations of plasma proteins *per se* (following administration of dextran) did not interfere with the healing of wounds. His conclusions were in agreement with those of previous investigators who had done similar experiments with acacia; he believed that delayed healing of wounds, associated with generalized hypoproteinemia, was due to the edema of the wound which had resulted from lowered osmotic pressure of the plasma. Maintenance of osmotic pressures by the circulating dextran prevented the edema, and healing of wounds was essentially unaffected.

Dextran-induced hypoproteinemia thus differs from a generalized hypoproteinemic state in several important respects. Body stores of protein are not depleted; the plasma proteins return to their previous concentrations readily; the usual hypoproteinemic sequelae are not observed; and with one exception, no decrease in antibody formation or resistance to infection has been noted. Thorsén[29] has recently called attention to the need for administering larger-than-usual doses of antitetanus serum to patients receiving dextran.

Methods of determining the concentration of plasma proteins are definitely affected by the administration of dextran.* The specific gravity of the plasma is affected (increased) by the dextran therein, and methods based upon plasma specific gravity are not accurate until three to four days after cessation of dextran therapy.

* A discussion of specific methods of determining proteins is included in part II.

EFFECT UPON CELLULAR ELEMENTS OF THE BLOOD

Values for hemoglobin, erythrocyte counts and hematocrit readings decrease immediately after the infusion of dextran. Bohmansson and co-workers have quantitatively estimated a 10 per cent decrease in these determinations after administration of 400 cc. of dextran. Simple hemodilution accounts for this change. The use of dextran in patients suffering primarily from loss of whole blood has therefore been recommended only as a temporary plasma volume expander or in combination with transfusions of whole blood.

The sedimentation rate of the erythrocytes may be increased after infusions of dextran. This change is due to the presence of the large molecules and varies with the molecular weight and plasma concentration of dextran.[7,27,30] Rouleau formation has been noted with concentrations greater than 0.5 gm. per 100 cc., and earlier solutions of dextran of very high average molecular weights tended to cause "sludging" or intravascular agglutination. The latter has not been found to occur to any significant degree with the current macrodex brand of dextran.[22]

Determinations of blood type may also be affected by the presence of dextran. Rouleau formation of the donor's erythrocytes interferes with direct matching, and dilution of the patient's serum may allow a weak agglutination to be overlooked. Turner and co-workers, however, have reported typing the blood of three patients before and after administration of dextran (macrose brand), and have found no difficulty in obtaining correct blood groups. Bloom[1] found no difficulty in typing, cross matching or Rh determinations in twenty-seven patients who had received dextran.

No significant alterations in the body electrolytes or the blood chemical findings occur after administration of dextran.[3]

EXCRETION AND BREAKDOWN OF DEXTRAN

The ability of the body to excrete or metabolize completely a large molecular substance is one of the chief criteria which must be satisfied by a plasma volume expander. Storage within the reticuloendothelial system or other tissues of the body remains one of the chief drawbacks to common acceptance of several earlier substances.

Excretion rates have been estimated by a number of workers studying consecutive plasma concentrations of dextran and the amount excreted via the urinary tract.[3,12,13,28] A rapid decrease in the initially high concentrations in the plasma occurs in the first few hours as the smaller molecules of dextran are excreted by the kidney or diffuse into the interstitial space. Thereafter the decline is gradual, uniform and in proportion to the amount of dextran remaining. Bull and co-workers estimated that one-third of the dextran present at any one time disappears during the next twenty-four hours. Plasma concentrations of dextran are low after three days and dextran can rarely be detected after five or six days.

Urinary excretion of the smaller molecules of dextran occurs chiefly in the first twenty-four hours and most of this in the first few hours after administration. Urinary values for dextran have been reported at this interval to be as high as 7.0 gm. per 100 cc. without evidence of renal damage.[28] Total amounts of dextran contained in the collected specimens of urine have varied from 9 to 50 per cent of the amount infused.[7] The length of time dextran has continued to be excreted by the kidney has varied from twenty-four to seventy-two hours according to most authors, with an occasional finding of traces of the substance in the urine up to the fifth or sixth day, rarely longer. Preliminary reports on studies with C^{14}-labeled dextran indicate that renal excretion probably accounts for more than 50 to 60 per cent of the dextran infused.

METABOLISM OF DEXTRAN

The eventual fate of the larger molecules of dextran is not completely explained by gradual renal excretion. Early suppositions that a gradual metabolic breakdown of dextran occurred in the body were indirectly supported by the excretion studies summarized heretofore, and also by extensive animal experimentation on the amount of dextran in the tissues.

Large amounts of dextran have been administered to various animals, including rabbits and dogs, and the animals later sacrificed. Ingelman[17] found no evidence of dextran in tissue extracts from the various organs. One dog had received periodic infusions of dextran over a four-year period without injurious effects. Hartman, using some of the first macrodex produced in this country, reported marked histologic evidence of retention in the tissue of mice, involving lymph nodes, liver, kidney and blood vessels. The findings of other studies of this type have, for the most part, been in agreement with the negative findings of the Swedish investigators.[17,28]

One often cited observation by Ingelman,[17] originally offered as the only supporting evidence that dextran is metabolized by the body, is that excretion rates for dextran in animals were increased by the simultaneous administration of thyroid hormone. Gray, Siiteri and Pulaski, however, recently stated that dogs, experimentally starved and phlorhizinized, have shown an increase in the excretion of dextrose during the twenty-four to forty-eight hours following the intravenous administration of dextran. This evidence may be an even more valid indication that at least a portion of the unexcreted dextran is metabolized to glucose.

Bloom[2] has recently reported that after twenty-four hours 68 per cent of the initial amount of dextran in the plasma had disappeared from the blood of nephrectomized rats as opposed to 89.3 per cent for normal rats. This represents only a 20 per cent decrease after nephrectomy. The final answer as to the breakdown of dextran awaits the results of studies in progress using radioactive C^{14}-tagged dextran.*

TOXICITY AND REACTIONS TO DEXTRAN

Hemopoietic depression or abnormalities have not been observed following the administration of dextran. The evidence on antigenicity is confusing and the literature contains many conflicting statements.

Turner and co-workers, using macrose† brand of dextran, reported a high incidence of reactions with this solution. One reaction occurred in a patient suffering from pneumococcal pneumonia. There has been some evidence of crossed antigenic response between dextran and certain strains of pneumococci, presumably due to the latter's capsular poly-

* Preliminary reports indicate a definite metabolic breakdown of a portion (26 per cent in one patient) of infused dextran as evidenced by labeled C^{14} in the expired air ($C^{14}O_2$).[15]

† It should be noted that "macrose," a trade name originally used by Schenley Laboratories for their dextran, has recently been transferred to their polyvinylpyrrolidone product.

saccharides. Apparent differences in the reported frequency of reactions was attributed by one author to the occurrence of certain strains of pneumococci in various regions.[23] Probably of more importance is the realization that different lots of Swedish dextran or macrodex, as well as products made in England and this country (to somewhat different specifications), have been used in the various studies.

Among the brands of dextran used earlier at the Mayo Clinic was the macrose which Turner and his group later reported as giving such a high incidence of reactions. This product gave rise to a number of anaphylactoid reactions, but only when administered to unanesthetized patients.[18] The later use of dextran pH and macrodex (Swedish) gave rise to no untoward reactions in anesthetized or unanesthetized patients.[19,20] Caution must be exercised, therefore, in reviewing some of the early reports in light of this improvement in the more recent products.* Thorsén[25] recently estimated an over-all reaction rate of approximately 0.2 per cent following the administration of dextran, with no serious reactions in the three years just prior to his report.

As yet unsolved is the high reaction rate which resulted from the administration of dextran to members of the Armed Services at Brooke Army Hospital.[24] The dextran of the Commercial Solvents Corporation gave a far lower incidence of anaphylactoid reactions (8.24 per cent) than did the Swedish macrodex (33.9 per cent) or the English dextran-saline (44 per cent). No report of the administration of dextran to civilian patients has included a significant incidence of anaphylactoid reactions with the exception of the aforementioned series. No death has yet been recorded, to our knowledge, as having been caused by the administration of dextran.

CHANGES IN THE PARENCHYMATOUS ORGANS

Hepatic function is not adversely affected by administration of dextran. Histologic changes consisting of areas of focal degeneration have been observed in experimental animals receiving large amounts of the macrose brand of dextran (Turner and co-workers). Mowry and co-workers found vacuoles of dextran (demonstrated by using alcoholic reagents and the periodic Schiff technic) within the hepatic cells of mice receiving dextran. These changes were increased slightly when the dextran was administered to mice suffering from shock.

That these changes, if present, do not result in sufficient reduction of the functional capacity to alter the more sensitive tests of hepatic function in man, has been demonstrated by several investigators. Bohmansson and co-workers found no change in the values for hippuric acid, phosphatase, bilirubin and urobilinogen after administration of dextran.

The effects of dextran upon the kidneys are somewhat more controversial. Changes much like those seen after administration of sucrose have been shown by many authors to be present after infusions of dextran. Goldenberg and co-workers reported that "in all rabbits and dogs sacrificed less than two days after an injection of macrose, swelling and granularity of the epithelial cells of the tubules of the kidneys were seen; these were associated with the presence of granular debris or homogeneous pink-staining globules in the lumen of the tubules. In some instances marked vacuolization of the epithelium and dilatation of the tubules was noted. The changes involved, in order of frequency, the proximal convoluted tubules, the distal convoluted tubules and the loop of Henle." The tubules appeared normal five days after cessation of the administration of dextran (macrose). Occasional glomerular and interstitial changes seemed to be related to the number of injections. When present the former consisted of homogeneous pink-staining of the loops. The glomerular and capsular epithelial cells had undergone a reactive hyperplasia in these specimens. According to most investigators, the renal tubular changes are the rule, glomerular alterations the exception.

Mowry and co-workers established a successful staining of dextran using alcoholic reagents and the periodic Schiff technic. Purple-staining material, not seen in untreated mice, was present in dextran-treated mice, with the following distribution: lumina of the blood vessels, vacuoles within the proximal convoluted tubular epithelium and casts in the tubular lumina. No evidence of extravascular glomerular deposits was noted. Renal changes were slightly more marked in mice suffering

* Recently developed products include hydrodextran, a solution of dextran in which final control of the range in molecular size is carried out by a new method.

from shock due to burns than in normal animals, both groups receiving the same amount of dextran.

Studies of renal function made on experimental animals and patients who have received infusions of dextran have given consistently negative results. The results of routine urinalysis have not been remarkable; studies of urinary output, excretion of sodium chloride and sediment have revealed no significant abnormalities in postoperative patients after administration of dextran.[3] Bloom,[1] and Fleming and co-workers studied renal function extensively; they determined concentrations of non-protein nitrogen and excretion of phenolsulfonphthalein, as well as clearances of para-aminohippurate and creatinine following infusions of dextran in man. No evidence of any decrease or abnormality of function could be detected. The histologic changes in the kidney are thus believed to be of a temporary nature and compatible with negative findings by means of the usual studies of renal function. The vacuoles in the tubular epithelium contain dextran itself or a closely related substance,[21] and the cells rapidly return to normal after cessation of dextran therapy.

SUMMARY AND CONCLUSIONS

In this review of the physiology of dextran certain inconsistencies in the literature have been pointed out and an attempt has been made to clarify the mode of action of dextran, to point out the results of its use in various conditions and to indicate any dangers attendant upon its administration. This substance has proved to be a satisfactory plasma volume expander and subject to fewer complications than previously discarded plasma substitutes. Parenchymatous changes due to storage are not observed in the organs of the body. Microscopic changes in the kidneys are temporary and do not cause or predispose to demonstrable alteration in the functional capacities of these organs. Rare anaphylactoid reactions may be observed but in our experience are extremely infrequent.

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Leger et al. tried ligation of the common hepatic artery as a surgical procedure that might prove of value in the therapy of cirrhosis of the liver. In two of these patients they also ligated the splenic artery. They tried ligation of the hepatic artery since it is a much simpler procedure than splenorenal or portacaval shunt. However, postoperative hemorrhage is always a danger, these authors admit, and therapeutic results are questionable at present. A final decision must be withheld pending results of hepatic artery ligation on a much larger series of cirrhotic patients. (*Richard A. Leonardo, M.D.*)

USE OF DEXTRAN (MACRODEX) IN BURNS

II. CLINICAL EVALUATION IN EIGHT CASES

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EVALUATION of the role of dextran (macrodex) in the treatment of severe thermal burns has lagged behind the investigation of its usefulness in shock of other causation. To be of use as a plasma volume expander in a large scale civilian emergency, its value in the immediate treatment of large numbers of patients who are burned must be thoroughly evaluated and any limitations clearly understood.

In Sweden, Rosenqvist and Thorsén have reported the use of dextran in the treatment of burns that involved more than 20 per cent of the surface of the body. They administered a 6 per cent solution of dextran in preference to human plasma, giving dextran and whole blood alternately. Their reported results were "comparable with the best obtained with blood and plasma. Macrodex has proved to be as good as plasma in maintaining the blood pressure and circulation. None of the usual objections to artificial colloid transfusion agents seem to apply to macrodex." The concentration of plasma proteins dropped to as low as 2.5 gm. per 100 cc. without evidence of increased edema in the burned areas or delayed resorption. They did stress, however, the importance of replacement of proteins by mouth whenever possible.

Bull and co-workers[2,3] reported the use of dextran in two cases of thermal burns. The more extensively burned patient died on the fifth day in the hospital. Postmortem findings included edema of the kidneys and desquamation of cells lining Bowman's capsule and the loop of Henle. This patient had received 4,540 cc. of dextran (English) in twenty-four hours. No measurable abnormality of renal function had been noted prior to death. The second patient, who had a burn that involved a limited surface of the body, was given 1,080 cc. of dextran. The values for plasma proteins returned to normal by the fourth day following infusion. Grafting was completed by the nineteenth day without complication.

In the United States the satisfactory employment of dextran in the treatment of burns has been noted briefly by Ravdin and Fitts in a report on plasma volume expanders.

Evans and his co-workers have recently stated that dextran appears as effective as plasma in the early treatment of shock due to burns. They limited their use of dextran to burns of limited extent (20 to 25 per cent of the body surface) and expressed preference for the use of pooled plasma if readily available. This preference is based on the presence of decreased concentration of plasma proteins, however, and not on the presence of toxicity or parenchymal damage.

The experience with macrodex** in the treatment of thermal burns at the Mayo Clinic is limited to eight cases. Extensive trial of this solution in surgical patients[5,9,10] since 1946 led to investigation of its usefulness in other conditions.

Five of the eight patients died of their severe burns and postmortem examinations were performed in four instances. The latter four cases are reported in detail, with an attempt at correlation between pathologic findings, the amount of macrodex administered and the interval after its administration. Macrodex, as a colloidal agent for combating the potential shock in such severe burns, was thought to be equal to human plasma in similar cases.

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** The term "macrodex" will be used throughout this discussion to avoid confusion with earlier brands of dextran. A 6 per cent solution in 0.9 per cent saline solution was administered in every case.

CASES IN WHICH NECROPSY WAS PERFORMED

CASE 1. A child, nine years old, was admitted within an hour after sustaining a thermal burn of 85 per cent of the body surface while he was playing with matches and a highly inflammable fluid. The face, entire torso, most of the upper extremities and all but the ankles and feet of both lower extremities were burned. It was later estimated that 80 per cent of the body surface was affected by third degree burns.

Moderate shock was present on the patient's admission to the hospital. While he was still in the emergency room, blood was obtained for laboratory studies and grouping, a plastic needle was introduced into the right greater saphenous vein at the ankle and an infusion of macrodex was started. Sterile pressure dressings were applied in the operating room. The requirements for fluid were calculated from Berkow's table of percentage involvement[1] and a formula similar to that recommended by Cope and Moore.

In the first period of fluid balance calculation (seventeen hours) the patient received 2,500 cc. of macrodex, 500 cc. of whole blood and 2,000 cc. of electrolyte solutions by vein. The urinary volume was only 150 cc. during this time.

The results of initial blood studies were as follows: hemoglobin 18.2 gm. per 100 cc., erythrocytes 5,650,000 and leukocytes 30,900 per cu. mm., and hematocrit reading 58 per cent. Urinalysis disclosed grade 2 albuminuria (graded on the basis of 1 to 4) and the presence of 8 to 30 erythrocytes, 3 to 20 leukocytes and a few granular casts per high power field. The specific gravity was 1.040 (after administration of macrodex).

The second period of fluid balance calculation was twenty-six hours, during which the patient received 6,070 cc. of fluids including 1,000 cc. of macrodex and 1,000 cc. of whole blood. The urinary volume reached 1,250 cc. during this interval.

In the first seven days he received a total of 7,400 cc. of macrodex. Most of this was administered during the early shock phase. Plasma, amino acid solutions and whole blood were preferentially administered in the later (hypoproteinemic) stage, as his oral intake of protein was minimal.

The clinical course was that of a desperately ill child who, after recovery from the pulmonary edema which occurred during the beginning resorption of tissue edema (third and fourth days), showed definite evidence of improvement for the next three days. Beginning on the seventh day, however, a steadily increasing elevation of temperature, pulse and respiration was observed. He lapsed into a semi-comatose state and died on the fourteenth day after admission.

Laboratory studies indicated that in spite of the large volumes of parenterally administered fluids, hemoconcentration persisted until the fourth or fifth day. Determinations of hemoglobin and erythrocytes revealed maximal values of 20.6 gm. and 5,780,000, respectively, on the third day. The hematocrit reading at that time was 68 per cent. Gradual decline of these values occurred with resorption of interstitial fluid. Urinalysis disclosed persistence of a small number of erythrocytes and leukocytes per high power field until shortly before death, when the latter increased slightly. All casts disappeared after the first three days, as did the albuminuria. Urinary volume was satisfactory, averaging 1,580 cc. per day for the first twelve days.

Postmortem examination revealed multiple small, healing pulmonary infarcts. Emboli had arisen from the right lower extremity which we were obligated to use almost continuously for parenteral administration of fluid.

The patient's severe hyperthermia and ultimate death were partially attributable to bilateral necrotizing papillitis and pyelonephritis. Changes consistent with those described following administration of macrodex were present in an early recovery phase (Fig. 1), with no obvious association between areas of pyelonephritis and areas in which macrodex had caused changes. The latter changes included granularity and swelling of the convoluted tubular epithelium, with moderate vacuolization and rare sloughing of these cells. Amorphous eosinophilic debris was seen in the lumen of these tubules. The architecture of the tubules was generally normal except for the focal, linear areas of dense leukocytic infiltration and necrosis of the acute suppurative pyelonephritis extending in columns from the pelvis to the capsule.

Blood chemical and fluid balance determinations were relatively normal at the time of death. There was minimal atrophy of hepatic cells. The adrenals were small, with a very

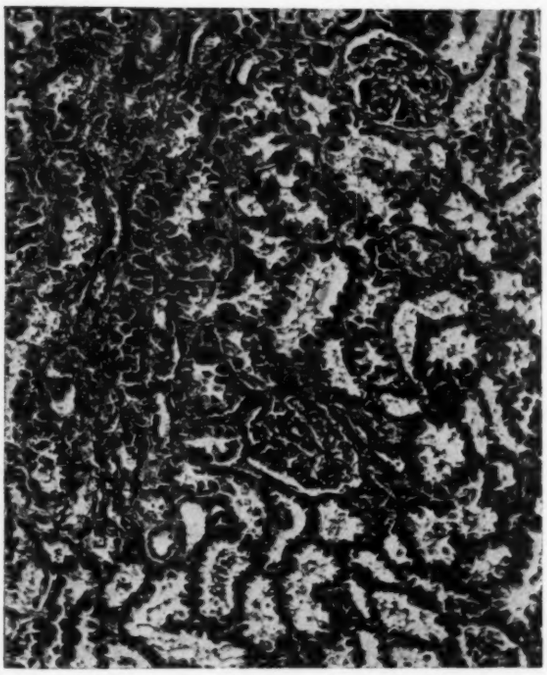

FIG. 1. Changes in the convoluted tubules of the kidney following administration of macrodex (7,400 cc.); there was a seven-day interval before death. This represents an early recovery phase with less swelling and vacuolization of the epithelium than are seen in the other cases. Some desquamation of cells has occurred. Early regeneration is present, with occasional mitotic figures. Hematoxylin and eosin, × 100.

thin cortex and loss of lipoid in all layers of the cortex.

Comments. That macrodex provided adequate initial correction of shock in Case 1 is attested by this patient's prolonged survival in the face of deep and extensive burns. Hemoconcentration was not completely corrected in the first seventy-two hours. Cope and Moore, and Evans and co-workers have recently stressed, however, that the danger of pulmonary edema places a limit on the total amount of colloidal as well as non-colloidal solutions which can be administered safely in an attempt to correct hemoconcentration. Involvement of more than 50 per cent of the body surface invalidates the linear ratio between the requirements for fluid and the percentage of surface involved, since the extracellular space cannot be safely expanded beyond a certain amount.

This patient's inability to take adequate protein supplements by mouth is a circumstance often present after extensive injuries. This represents an obvious contraindication to the prolonged and exclusive use of macrodex in treatment of the severely burned patient if we are to correct or minimize the post-burn hypoproteinemia. Values for serum proteins ranged from 3.2 to 4.3 gm. during administration of macrodex, the lowest value being present on the eighth day. It is questionable whether the proteins, provided by an equivalent amount of human plasma (7,400 cc. of plasma containing at most 440 to 450 gm. of protein), would be of significance in the long-range maintenance of nitrogen balance.

Parenchymal renal changes were present as already noted. (Fig. 1.) These findings are typical of changes caused by macrodex in the late or recovery stage. It is the opinion of one of us (W. A. B.) that there is no evidence to suggest predisposition on the part of these lesions to lead to the acute necrotizing papillitis and associated pyelonephritis which developed. The results of urinalysis were not unusual for a widespread burn. Lack of more striking laboratory evidence of the acute, terminal, renal inflammatory process may be explained on the basis of blockage of the involved collecting tubules. Antibiotics had been administered throughout hospitalization but pseudomonas and proteus were readily cultured from the kidneys at necropsy.

Changes in the adrenal cortex were similar to those seen after cortisone therapy. The latter agent was being evaluated in the treatment of severe burns at the time this patient was being treated.

CASE II. A man, forty-eight years old, was admitted within a half hour after 85 per cent of the body had been burned in a gasoline explosion and fire. The burn involved the face, neck, upper extremities, flanks, buttocks, thighs, legs and scattered areas of the thorax. Estimation of total second and third degree involvement was 70 per cent. Shock was present on the patient's arrival, with rapidity of the pulse and profuse sweating from uninvolved surfaces.

This patient was treated by the exposure or open method which is being evaluated currently. After removal of all remnants of clothing, minimal débridement of necrotic tissue was carried out in the operating room. The patient was then placed in bed upon sterile sheets.

Initial laboratory studies disclosed the following findings of note: hemoglobin 16.9 gm.,

erythrocytes 4,770,000, hematocrit reading 52 per cent and serum proteins 5.4 gm. Urinalysis revealed a specific gravity of 1.036, grade 2 albuminuria, and the presence of 1 to 8 erythrocytes, 3 to 20 leukocytes and a few granular casts per high power field.

The patient received 4,200 cc. of macrodex in the first period of fluid balance calculation (twenty-three hours). In addition, he received 1,000 cc. of whole blood and 620 cc. of electrolyte solutions intravenously. Oral intake was 2,455 cc. The urinary volume was 470 cc. for this period and gross hematuria was observed.

During the second day of treatment he received 1,750 cc. of macrodex and 2,400 cc. of electrolyte solutions by vein. Additional intake by mouth was 1,480 cc. Urinary output remained low (165 cc.) and partial renal shutdown was presumed. The urine was blood-tinged; albumin, erythrocytes, leukocytes and casts were present. The hemoconcentration had increased as determined on the basis of a rise in concentration of hemoglobin (19.6 gm.) and an increase in the hematocrit reading (72 per cent). This occurred in spite of the administration of the maximal amount of fluids advisable in the first twenty-four hours (10,000 cc.). Beginning resorption of edema fluid after the second day decreased the hemoconcentration rapidly. Moderate electrolyte imbalance with a tendency toward acidosis was noted. The concentrations of carbon dioxide were 15.8 mEq. (second day) and 13.7 mEq. (third day) per L.

Clinically, the patient's condition was critical from the time of admission. Abdominal distention became evident on the second day and vomiting ensued. Hematemesis became marked and he died on the third day of hospitalization, shortly after passage of a Levin tube.

Postmortem examination revealed bilateral hemorrhagic pulmonary edema with copious amounts of blood-tinged mucus and coffee-ground material in the trachea and bronchi. Desquamation of the mucosa of the entire esophagus was present. Necrosis with ulceration and erosion of the gastric and duodenal mucosa was marked. Coffee-ground material, like that seen in the respiratory tree, was present in the small intestine.

Grossly, the right kidney showed scarring from an old pyelonephritis. Microscopically, in addition to the healed residue of the previous inflammatory process, the convoluted tubular epithelium was swollen and the granular cytoplasm contained many minute vacuoles. Minimal nuclear disintegration had taken place and cell boundaries were somewhat indistinct. Amorphous eosinophilic debris was present in the tubular lumina. (Fig. 2.)

The parenchymal cells of the liver exhibited slight swelling and granularity of their cytoplasm. Here and there tiny vacuoles could be noted within the cells. These vacuoles contained neither glycogen nor fat.

Hyperplasia of the cortex was noted in both adrenal glands. Both corticotropin (ACTH) and cortisone had been administered to this patient.

Comments. This patient was suffering from shock on admission. His wounds were extensive and deep, as is rather typical of those caused by burning gasoline. Ulcerative changes in the upper part of the gastrointestinal tract were marked, even for a severe burn, and led to the abdominal distention, vomiting and hematemesis. The precipitating factor in the sudden death of this already critically ill man was his aspiration of a large quantity of coffee-ground fluid before the distended stomach could be emptied.

Urinary output was low for the first twenty-three hours in spite of theoretically adequate fluid intake and shock therapy. Oliguria increased on the second day and the urine was grossly blood-tinged. The minute focal areas of healed pyelonephritis could have played no part in the renal failure. Of importance in the oliguria was the loss of fluids into the gastrointestinal tract. Evans and co-workers have pointed out the increased incidence of shock in burned patients who exhibit an outpouring of fluid into the lumen of the gut. Superimposing this onto the loss of fluid into the interstitial space and from burned surfaces increased the gravity of the prognosis.

Renal shutdown has long been one of the feared complications of severe burns with their associated shock and toxicity. The effect of adding macrodex-induced tubular changes to those associated with the so-called lower nephron nephrosis* of shock is not completely known. Pre-existing mercurial nephrosis, how-

* The term "lower nephron nephrosis" may not be correct in many instances because the entire nephron may be involved (W. A. B.).

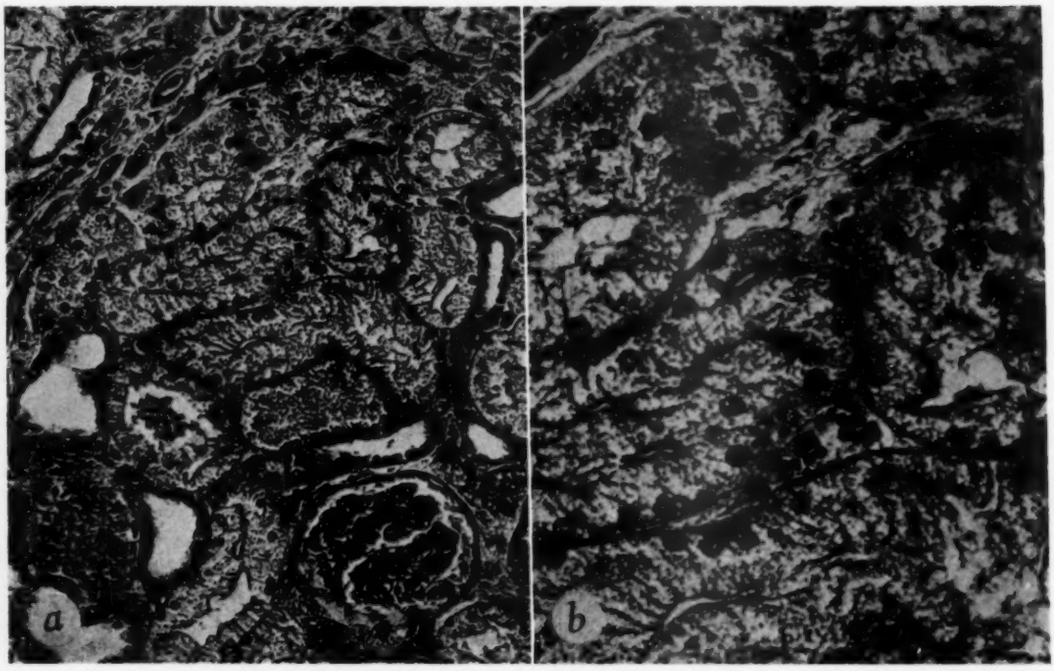

FIG. 2. Sections stained with hematoxylin and eosin. The patient received macrodex (5,950 cc.) up to twelve hours before death. (*a*) The cytoplasm of the tubular epithelium is granular and vacuolated. The swollen epithelium fills the lumen almost completely. Minimal desquamation is observed. × 160. (*b*) Higher power view to show the vacuoles and granularity of the cytoplasm plus obliteration of the lumen of the tubules. × 390.

ever, has not increased the degree of macrodex-induced tubular changes in experimental animals.[7] Macrodex-induced changes overlap certain pathologic findings typical of the "lower nephron syndrome" or shock kidney. Findings common to both processes include early swelling of the tubular epithelial cells, loss of distinct cellular boundaries, and later, nuclear disintegration. The cellular debris and other materials within the lumen of the tubules are difficult to differentiate in these two conditions. By means of special stains, however, the hemoglobin by-products contained in the tubular casts of the "lower nephron syndrome" can be identified. Also, pathologic changes in the interstitial tissues, with occasional thrombosis of adjacent veins, are distinguishing features of the latter condition.

Mowry and co-workers found that macrodex (dextran)-induced changes were slightly increased if mice were subjected to thermal burns before administration of the macrodex.

CASE III. A housewife, thirty-five years old, received a burn of 75 per cent of the body surface when a gas water heater exploded while being lighted. She received 8,900 cc. of fluid in the first thirty hours, including 760 cc. of macrodex, 1,000 cc. of whole blood and 3,000 cc. of plasma. An additional 760 cc. of macrodex was included in the fluids received intravenously on the second day. Hemoconcentration existed for the first thirty-six hours but decreased thereafter. The initial urinalysis revealed a few hyaline casts, 1 to 8 erythrocytes and occasional leukocytes per high power field. Urinary volume was adequate.

The clinical course was unfavorable although shock was counteracted and hemoconcentration decreased. Her temperature remained elevated in spite of antibiotic therapy and she became somewhat disoriented on the second day. Death occurred sixty-four hours after admission when respiration suddenly ceased without an obvious, terminal precipitating incident.

Postmortem examination revealed recent hemorrhages in both adrenal cortices. There was hemorrhagic edema of both lungs, and scattered erosions of the stomach and duodenum were present. The kidneys showed changes characteristic of those induced by macrodex, much like those of the previous case. (Fig. 3.) Some of the tubular epithelial

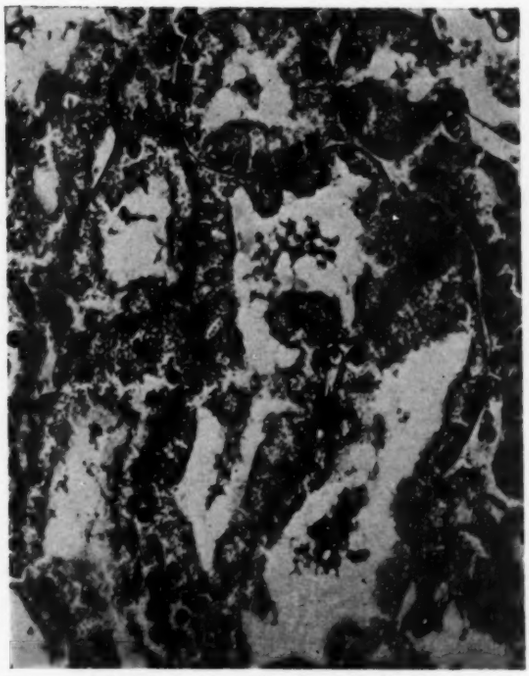

FIG. 3. The patient received macrodex (1,520 cc.) up to twenty hours before death. There is swollen tubular epithelium with frequent granulations and an occasional vacuolated cell. The debris (macrodex?) filling the irregular lumina is well demonstrated. Hematoxylin and eosin, × 275.

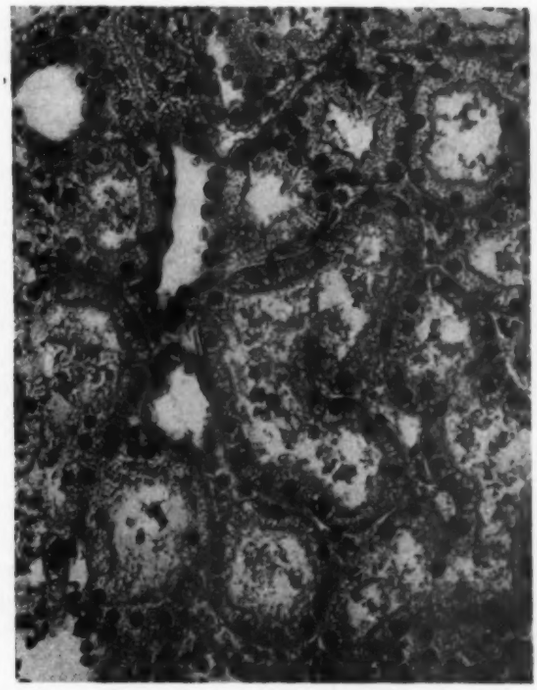

FIG. 4. The patient received macrodex (1,140 cc.) up to a few hours before death. Swollen, granular, vacuolated tubular epithelium with some breakdown of the cytoplasm is evident. Granular debris is present in the lumina. These changes are primarily in the proximal convoluted tubules. Hematoxylin and eosin, × 275.

cells were swollen and had indistinct cell borders. Granularity and moderate vacuolization of the cytoplasm were noted, with rare sloughing of the cells. Amorphous eosinophilic debris was present in the tubules and, occasionally, in Bowman's spaces.

Comments. The small amount of macrodex administered in the foregoing case played little part in the patient's clinical course. Renal changes were similar to those seen in Case II. The total amount of macrodex (1,520 cc.) given was far less than in Case II and no evidence of renal failure or functional abnormality was obvious, yet the histologic tubular changes were very much alike.

CASE IV. A housewife, forty-five years old, sustained a burn of 60 per cent of the body surface in a kerosene explosion. Primary treatment was carried out elsewhere and she came to us sixteen hours after injury. She had been given 1,000 cc. of pooled human plasma and 2,000 cc. of electrolyte solutions before transfer. Macrodex was administered on arrival; a total of 760 cc. was given during the first day and 380 cc. on the second (plus other fluids). Vomiting and hematemesis were present on admission; the extremities appeared somewhat cyanotic and remained so until her death thirty hours after arrival (forty-six hours after injury).

Postmortem findings included acute ulcerative esophagitis, hemorrhagic edema of the lungs and moderate renal tubular lesions, the latter consistent with those induced by recent administration of macrodex. (Fig. 4.) The parenchyma of the liver was essentially normal grossly and microscopically.

Comments. Here again the tubular changes of macrodex were in evidence after administration of a relatively small amount of the solution (1,140 cc.) and after a short interval of time. No abnormality of renal function was noted.

Ulcerative changes were present in the esophagus. Thus, in all four cases there were erosions or ulcerations of the upper part of the gastrointestinal tract.

Renal Changes Complicating Burns. That renal changes are frequent complications of burns is well known. For comparative purposes, necropsy data were reviewed in four cases of burns in which no macrodex had been

used. Moderate congestion of the kidneys was noted in two of the four cases, and slight swelling of the tubular epithelium was present in one of these. In another case there were changes typical of "lower nephron nephrosis." There were no tubular changes, however, which could be confused with macrodex-induced changes.

Goodpastor and co-workers have reported on the renal pathologic findings in a series of forty-seven necropsy cases in which treatment with macrodex had not been given. The kidneys were abnormal in twenty cases, in all of which there was clinical and laboratory evidence of persistent renal dysfunction. In two patients there was acute pyelonephritis. Otherwise, the pathologic changes were homogeneous and consisted of tubular necrosis and the presence of pigment and cellular casts in the tubules. The pigmented casts were identifiable as blood pigments and there was a close correlation between the presence of clinical hemoglobinuria and the postmortem findings of pigment casts. The more marked renal changes were associated with the more severe burns, the existence of shock and the presence of significant intravascular hemolysis with hemoglobinuria. This study serves to emphasize the frequency and nature of the renal lesions resulting from severe burns and their sequelae.

There were no hemoglobinuric nephrotic changes at necropsy in our cases in which macrodex had been used. Consistently present, nevertheless, were the macrodex-induced tubular changes. There seemed to be only moderate quantitative correlation between the extent of tubular changes and the amount of solution administered. More important was the amount of time elapsed between the final infusion of macrodex and the time of death. Vacuolization of the tubular epithelium was less marked in the kidneys of the patient who received 7,400 cc. of macrodex, seen seven days after the last infusion, than in the kidneys of the last two patients who received much less macrodex but died after a shorter interval. This speaks for the reversibility of these changes even in the patient who is subject to renal damage of other types.

Hepatic parenchymal changes were inconstant and in no case marked. Parenchymatous lesions of the other organs, such as one might see as a result of reticuloendothelial storage, were not observed in this group of patients.

CASES IN WHICH NECROPSY WAS NOT PERFORMED

The remaining four burned patients in the series of eight who received macrodex at the Mayo Clinic had involvement of 25 to 55 per cent of the body surface. Their ages ranged from sixteen to eighty-five years. Three of the four patients were males and three received the primary treatment for their injuries at the clinic. The fourth patient's burns had been dressed by his local physician.

The amount of macrodex administered ranged from 380 to 1,900 cc. Various other fluids were administered in these cases. Shock and hemoconcentration responded satisfactorily in the initial period of treatment. While three of these patients survived, one woman aged eighty-five died twelve days after 55 per cent of the body surface had been burned. Permission for postmortem examination was not obtained. Renal failure was not a factor in her death.

One forty-six year old man, who received 1,900 cc. of macrodex in the first five days after 42 per cent of the body surface had been burned, had albuminuria on admission; erythrocytes and leukocytes were also present in the urine. Repeated urinalysis revealed that erythrocytes were present until twelve days after admission, leukocytes for twenty-six days and minimal albuminuria up until the time of dismissal. The concentration of blood urea was 16 mg. per 100 cc. on the third day of treatment. No abnormality of urinary volume or concentration was noted. Pre-existing renal disease was not known to be present but may have existed.

The lowest concentration of serum proteins in this group of patients was 3.9 gm. per 100 cc. This measurement followed the administration of 1,580 cc. of macrodex, had risen to 4.5 gm. on the fifth day and was found to be 5.3 gm. on the seventeenth day of treatment.

The values of blood urea, and electrolytes and the erythrocyte counts were not significantly abnormal for a group of burns. The highest recorded value for urea was 36 mg., electrolyte balance was satisfactory in all and the lowest erythrocyte count was 3,810,000 (average for the lowest count in each case, 4,000,000 per cu. mm.).

REMARKS

The multiplicity of variables encountered in the evaluation of burn therapy is obvious to anyone familiar with the handling of such cases. Macrodex has proved to be a satisfactory plasma volume expander in the early or shock phase of thermal burns. No reactions of an antigenic or allergic nature have been encountered with the use of macrodex (Swedish*) in this group of patients. Neither has the hemodilution anemia been a problem in these cases.

Concentrations of serum proteins are affected by macrodex in two important ways. An understanding of these factors is even more important in the treatment of burns than in other conditions. The concentration of proteins decreases after infusion of macrodex by the two mechanisms described in part 1; simple hemodilution occurs, plus an active supplanting of plasma proteins by the macrodex. The latter is most likely a homeostatic mechanism which prevents osmotic "hypertension."[14] Equally important in evaluation of the nitrogen balance of burned patients is the laboratory method used to measure proteins. Specific gravity (for example, copper sulfate) methods will provide a day-to-day comparison of total colloids (plasma protein plus macrodex) but will be inaccurate for protein itself in the presence of macrodex. A modification of the Kingsley biuret method for determination of proteins has been devised[12] for use in the presence of macrodex. Trichloroacetic acid is employed to precipitate the proteins from the sample of serum, the macrodex remaining in solution. The sample is then centrifuged, the supernatant fluid containing macrodex is discarded and the protein precipitate is redissolved in alkali.

Any increase in hypoproteinemia attributed to administration of macrodex is, in actuality, a purely temporary alteration of the circulating component of the stores of protein in the body. To those who consider the use of macrodex as depriving the patient of the proteins contained in pooled human plasma, it must be recalled that at least a portion of such proteins are utilized for their caloric value during the acute stage of the burn.

Oral intake of protein supplements is, nevertheless, a necessary adjunct of burn therapy and takes on even greater importance with the prolonged use of macrodex. One must not lose sight of the value of whole blood administration in the potentially hypoproteinemic patient.

Blood type and Rh determinations have not been noticeably affected by administration of macrodex in our experience. Withdrawal of a sample of blood for grouping and Rh determinations should probably be carried out on arrival of the burned patient in any case. This would completely obviate any possible difficulty in accurate typing and cross matching for purposes of transfusion.

Changes in the renal tubules emerge as the remaining factor in question before widespread acceptance of macrodex as a therapeutic agent for treatment of severe burns occurs. We are in full accord with Evans and co-workers and with others who have recommended the use of macrodex as a plasma volume expander in the treatment of burns of limited extent. Beyond this, our experience leads us to recommend macrodex as a useful agent in the early stages of more extensive burns, with one reservation. Evidence of renal shutdown or hemoglobinuric nephrosis should, at present, be considered an indication for the preferential use of pooled human plasma. Therapy with whole blood might also be used primarily, if the renal failure is on the basis of secondary shock and not from a transfusion reaction with hemoglobinuria.

The diagnosis of impending renal failure is at times very difficult in burned persons. Traces of albumin and occasional casts, erythrocytes and leukocytes may be present in the urine without indicating renal shutdown. The presence of an indwelling urethral catheter may lead to congestion, submucosal hemorrhages and frequently to erosions of the vesical mucosa, with small numbers of erythrocytes and leukocytes in the urine.

The development of oliguria in cases of burn necessitates differentiation between renal failure and so-called water deprivation. One simple differential diagnostic aid is not accurate following infusions of macrodex: the specific gravity, usually low in renal failure and high in water deprivation, is regularly elevated by the excreted macrodex. The water tolerance test as described and recommended by Cope and Moore continues to be of the greatest aid in differentiating these separate causes of decreasing renal output.

* Swedish macrodex will appear under the name "pharmadex" in the near future.

SUMMARY

Macrodex has been administered to a limited series of burned patients. The correction of existing shock and depletion of blood volume has been satisfactory. No untoward reactions or complications attributable to macrodex have been encountered in these patients.

Markedly lowered concentrations of plasma proteins or hemodilution anemias have not been a problem, and a method for determination of serum proteins in the presence of macrodex is presented. Macrodex is recommended primarily for use in the early or shock phase of burns and in conjunction with administration of whole blood. The oral route should be utilized whenever possible for administration of protein supplements and as much of the required electrolyte and other noncolloidal solutions as practicable.

Favorable results from the use of macrodex in the treatment of burns, such as are reported herein and by other investigators, should stimulate continued use and evaluation of its merits in large series of burns.

Necropsy studies in cases of severe burns in which macrodex was given reveal a singular lack of significant pathologic changes resulting from this plasma volume expander, with the exception of reversible renal changes in the proximal and distal convoluted tubules. Further investigation of the relationship, if any, between macrodex-induced changes in the convoluted tubules of the kidney and those associated with the syndrome of "lower nephron nephrosis" is desirable.

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MEDICOLEGAL IMPLICATIONS OF PARALYSIS OF THE RECURRENT LARYNGEAL NERVE*

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WHEN postoperative vocal cord paralysis exists following thyroidectomy, the surgeon is immediately open to criticism. That this is unjust will be seen after a careful analytic study of the subject. While goiter is a predominant cause of paralysis, it must not be construed that this is always due to severance of the nerve. Jackson[1] states, "Any goiter large enough to require removal has already imperiled the integrity of the recurrent laryngeal nerve. Even a small goiter, if it extends retrotracheally, has risked laryngeal paralysis. Our clinical experience has shown that an overlooked preoperative unilateral paralysis has been present in most cases of bilateral paralysis deemed postoperative. Even when due to operation, it is not to be construed as a cutting of the nerve."

Charles A. Fiertz[11] says, "In an experience with 30 cases of vocal cord paralysis, it has been shown that the great majority of vocal cord disabilities following thyroidectomy are not due to actual severance of the nerve but rather to a more or less severe traumatism."

Heyd[8] states, "I am convinced that traction is a dangerous procedure and particularly in substernal goiters." He also says, "It is not a uniform practice to examine the larynx of every patient with a goiter but when a competent laryngologist has examined every patient, one is surprised to learn that approximately 10% of goiterous patients have a one-sided vocal cord paralysis before operation. It is alleged that approximately 15% to 20% of patients operated for goiter have, at some time postoperatively some disability of the vocal cords. One would judge from the literature that about 3% have permanent vocal cord disability in varying degree."

A review of the anatomy will help us understand the pathology and clinical manifestations.

ANATOMY

The nerve supply to the larynx is from the vagi which run a long course. (Fig. 1.) Preganglionic fibers pass from the cortex to the ambiguous nucleus just above which they decussate incompletely. A lesion in the cortex could not cause paralysis because of this bilateral preganglionic innervation but one occurring just above the ambiguous nucleus might do so. Jackson[1] reports a chondroma occurring in this area and causing paralysis.

The vagus nerve originates from the ambiguous nucleus and contains both sensory and motor fibers. The superior laryngeal branch of the vagus nerve arises from the ganglion nodosum high in the neck, and passing behind the internal carotid artery, soon divides into the external and internal laryngeal nerves. (Fig. 1.) The latter enters the thyrohyoid membrane and supplies the larynx with sensory branches only. The external branch courses downward and is medial to the superior thyroid vessels and close to the thyroid cartilage. It supplies the cricothyroid muscle. Injury to the superior laryngeal nerve, i.e., the external branch, causes paralysis of the cricothyroid muscle which is a tensor of the cord and has to do with the range of the voice. This nerve is in danger every time the superior pole of the thyroid is dissected and ligated.

The vagus nerves continue down into the chest. (Fig. 2.) The left nerve crosses the arch of the aorta; and as it does so, it gives off the recurrent laryngeal nerve which winds around the artery and ascends into the neck. The right vagus nerve crosses the right subclavian artery and at this level gives off the right recurrent laryngeal nerve which encircles the artery and passes up posteriorly into the neck. Both recurrent nerves pass upward and medially to reach the groove between the esophagus and the trachea.

The recurrent laryngeal nerve as it proceeds up the neck forms a triangle (Semon's) with the common carotid artery and the inferior thyroid artery. (Fig. 2.) The latter springs from the thyrocervical trunk, passes medially behind the common carotid and, as it approaches the

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thyroid gland, breaks up into branches. As the nerve proceeds upward, it may lie behind, in front of, or pass between these vascular branches. (Fig. 3A, B and C.) Should hemorrhage occur from any of these branches, the nerve is endangered. Both nerves divide into two branches just before they reach the larynx —anterior (lateral) and posterior (more medial). (Fig. 4.) The latter runs up to supply the posterior cricoarytenoid, the interarytenoid (adductor) and the arytenoepiglotticus.

Although the nerve usually divides high up behind the cricothyroid articulation (Fig. 3E), it may branch very low down in the neck into two or even more branches. These smaller and more delicate nerves are very easy to damage. Again, one of these branches may be deep to, superficial, or go through between the branches of the inferior thyroid artery. The recurrent nerve may be given off from the vagus in the neck and may proceed directly to the cricothyroid area. (Fig. 3F.) It may also go down the neck and wind around the trunk of the inferior thyroid artery and come back up the neck. (Fig. 3D.) Naturally, these abnormalities leave it more susceptible to injury.

King[19] states the he has never known an instance in which the interarytenoid is supplied by any other nerve than the recurrent laryngeal. Heyd,[3] Nordland,[4] and Frazier[9] believe that this muscle is sometimes supplied by the superior laryngeal. It is known that the superior laryngeal anastomoses with the posterior branch of the recurrent nerve by means of the nerve of Galen. (Fig. 4.)

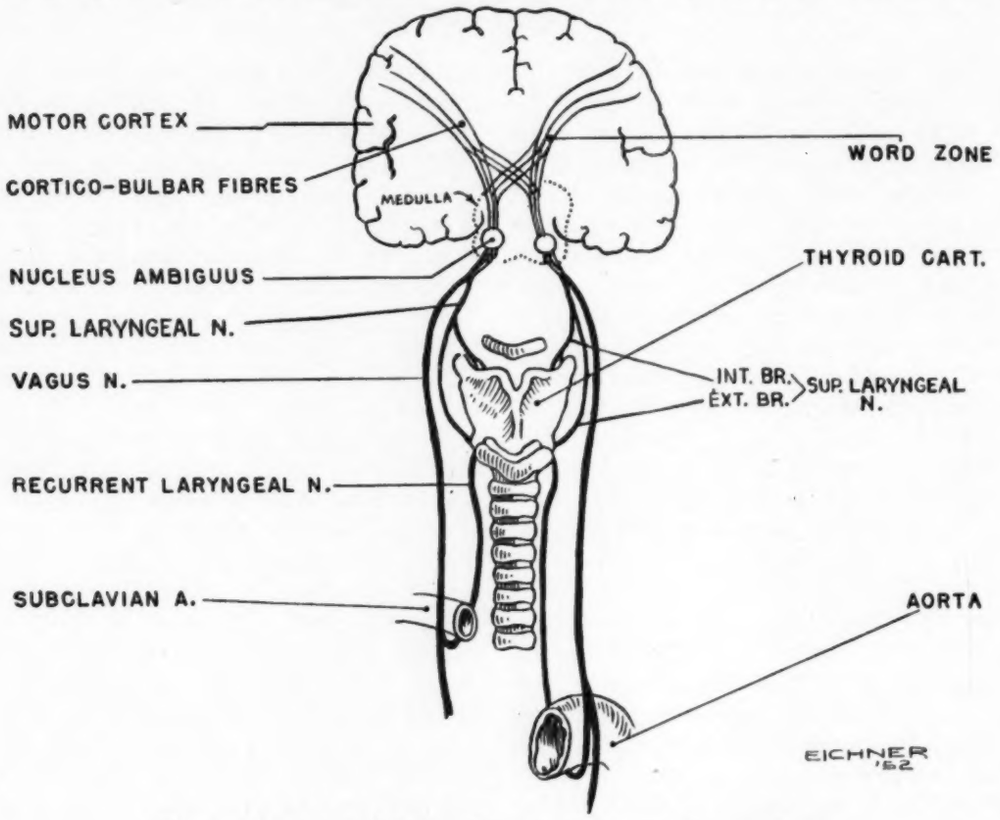

FIG. 1. Concept of original and course of recurrent laryngeal nerve.

It may be seen, therefore, that when the trunk of the recurrent laryngeal nerve is damaged, there is a paralysis of both adductors and abductors and constrictors of the larynx on that side. However, the main adductor, i.e., interarytenoid muscle, is supplied by both nerves and the cord would be drawn to the midline and could not be abducted. (Fig. 5B.) The opposite cord can be abducted so there is room for respiration and there is also phonation as the normal cord can be adducted to the midline. (Fig. 5E.) Often there is some weakness and hoarseness but these may be so minor as to be overlooked entirely.

When there is injury to both nerve trunks, adductors as well as abductors are paralyzed. The usual condition produced is a relaxed con-

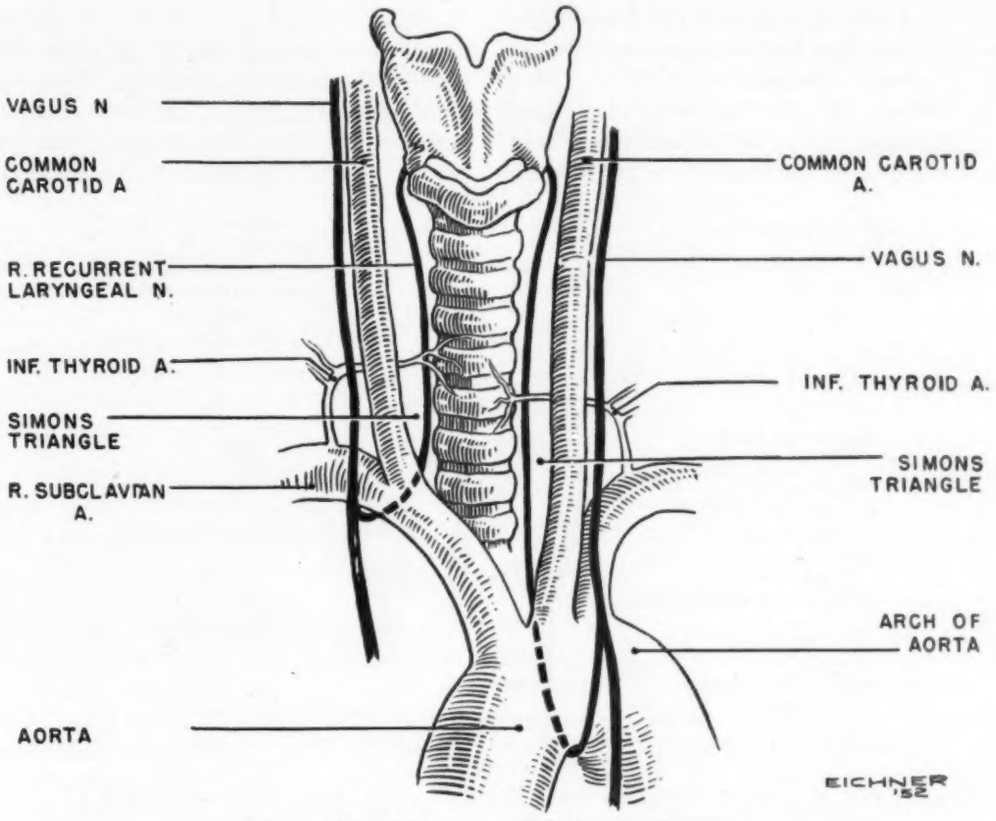

FIG. 2. Shows the course of the two vagi nerves.

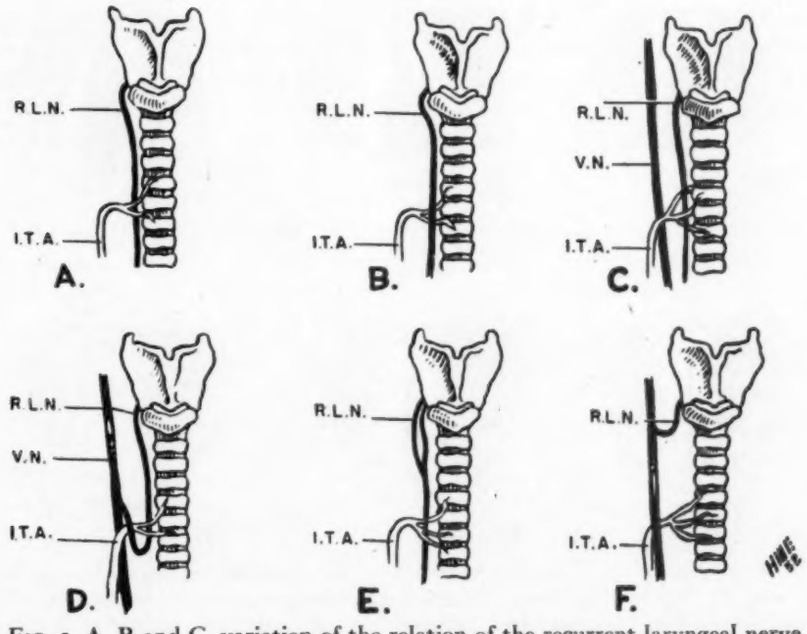

FIG. 3. A, B and C, variation of the relation of the recurrent laryngeal nerve to branches of the inferior thyroid artery; D, a variation where the nerve encircles the inferior thyroid artery instead of the subclavian artery; E, low division of the nerve; F, a recurrent nerve given off high in the neck and not going down into the chest. R. L. N. = recurrent laryngeal nerve; I. T. A. = inferior thyroid artery; V. N. = vagus nerve.

dition of the cords and they settle down into a position midway between adduction and abduction, i.e., cadaveric position. (Fig. 5C.) If the anterior branch of the recurrent laryngeal nerve is damaged, there is abductor paralysis and the cord is in the adducted or the midline position. If this damage is bilateral, the cords are both adducted and breathing is markedly impaired. Immediate tracheotomy may be necessary. When both trunks of the recurrent nerve are damaged, the cords may not always assume the cadaveric position. They may settle down to the midline position (Fig. 5F) and tracheotomy may be necessary. Some authorities[3,4,9] believe that the midline position is often due to abnormal innervation to the adductor muscle. The recurrent nerve carries both adductor and abductor fibers, the latter being

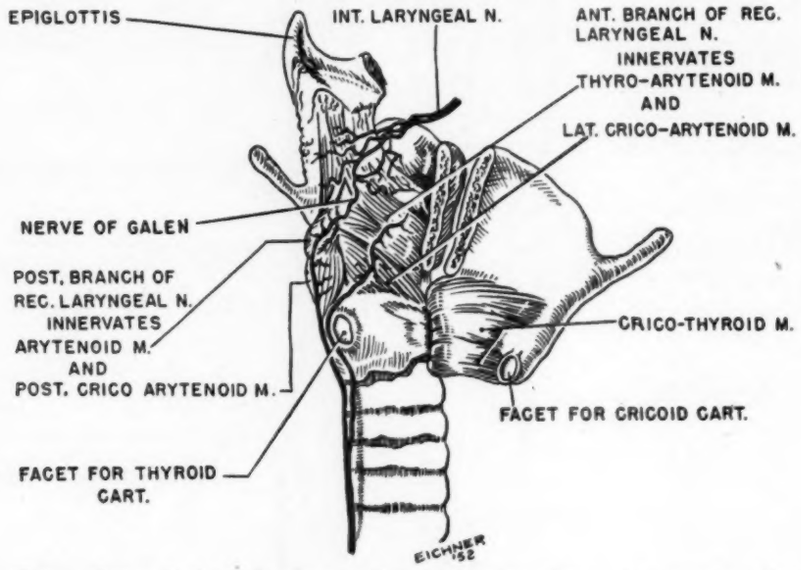

FIG. 4. Lateral view of recurrent laryngeal nerve. Note the nerve passing behind the cricothyroid articulation.

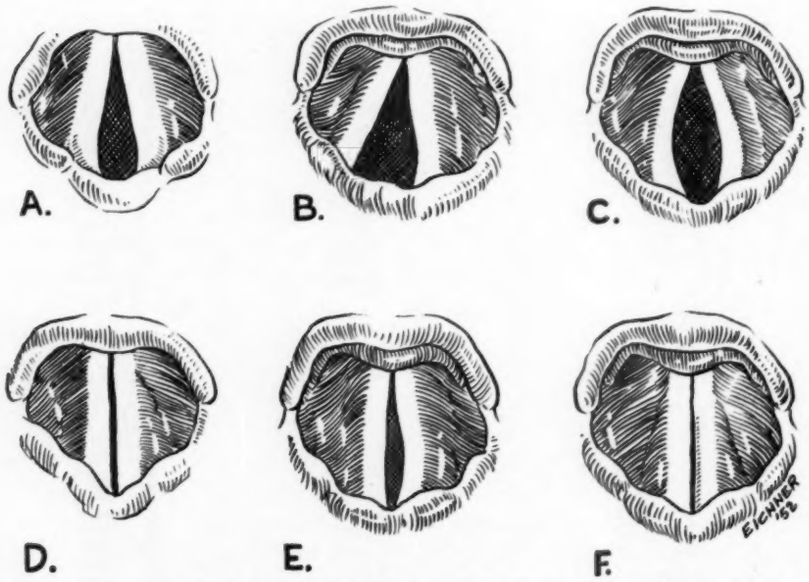

FIG. 5. A, normal larynx in inspiration; B, unilateral paralysis in inspiration; C, bilateral midline paralysis (cadaveric position); D, normal larynx in phonation; E, unilateral paralysis in phonation; F, bilateral midline paralysis (assumed in some cases).

more susceptible to damage according to Semon's "law," namely, the abductor muscles of the larynx have a greater tendency to motor impairment than the adductor muscles. When partial injury occurs to the nerve, therefore, abductor paralysis is likely to occur. If the posterior branch is affected, the cord or cords (if bilateral) are widely abducted due to adductor paralysis. Phonation is impossible and may necessitate the "reverse King operation" for its correction, i.e., the cords must be sutured closer together.

PATHOLOGY

Goiter itself is a predominant cause of paralyses. It may damage the nerve by pressure especially in deep retrotracheal or substernal goiters. Carcinoma of the thyroid may invade the nerve. The inflammatory reaction and the fibrosis of thyroiditis may extend outside the gland and involve the nerve. Following surgery there may be tumefaction, mild infection and fibrosis sufficient to press on the nerve and cause the gradual onset of paralysis. The long course of the nerve, starting as it does from the medulla and coursing down through the chest and back up again into the neck, makes it vulnerable to injury in any location through which it passes. For the sake of brevity, Table 1 has been prepared to show the wide variety of disorders from which the nerve may be injured.

Surgeons must admit, however, that there is an incidence of operative damage to the nerve. The nerve may be severed or it may be included in a ligature. King[11] mentions a case in which paralysis was noted in a patient being taken back to her room from surgery. He brought her to surgery again, opened the wound and took a ligature off the nerve. He states that if a ligature is left on longer than two hours, it is too late for recovery to take place. He urges light anesthesia so that the voice may be tested following surgery, and believes that the cords should also be inspected. While there is no unanimity of opinion, most surgeons believe that as soon as a nerve is damaged there is some degree of change in breathing noticeable by the anesthetist. This varies in degree but there may be sudden severe dyspnea and stridor, and may even account for some deaths on the table.

Heyd[3] states that excessive traction may cause damage to the nerve. Lahey[2] believes that wide exposure obtained by dividing the strap muscles is necessary. He then retracts the common carotid outward and ligates the trunk of the inferior thyroid artery as it passes medially behind the common carotid artery. He then finds the nerve and protects it. This maneuver has lowered the incidence of nerve damage in his hands to less than .3 per cent.

Dinsmore[3] heads another school of thought. He states, "The less I see of the nerve the better I like it." His reasons are: (1) If the clamps are placed horizontally and close to the gland, the nerve will not be injured. (2) In a search for the nerve, hemorrhage may occur and trauma to the nerve may result. (3) The syndrome of abductor paralysis can occur without operative injury to the nerve. (4) The nerve itself is not an inherently strong nerve and is susceptible to degeneration from the mere operative exposure and handling. (5) Cicatrization around the nerve is an important factor in nerve disability.

We have been exposing the nerve in a high percentage of cases but do not always do so. Emphasis should be placed on the delicate handling of tissues. If the nerve is exposed, it should not be traumatized by stripping it out of its bed and demonstrating it to an audience. Pulling on the gland and stretching the nerve is to be condemned. We like to use fine mosquito forceps for the delicate dissection. Rigid hemostasis will limit postoperative tumefaction and fibrosis.

Injury to the superior laryngeal nerve may occur in ligating the superior thyroid artery. We have found it useful to spend considerable time in freeing the upper pole from surrounding tissues, including the sternothyroid muscle. This allows ligatures to be placed directly on the vessels. Sweeping widely around the tissues might easily include the superior laryngeal nerve or its external branch. This leads to tensor cord paralysis.

CLINICAL MANIFESTATIONS

There is a wide variety of disability following surgery. The majority are caused by local pharyngitis and tracheitis. This may be aggravated by the trauma of intubation by the anesthetist. When paralysis occurs, there may be a wide variety of bizarre reactions. These may be due in part to the wide power of adaptability to change in the larynx. Also, there may be only partial division of the nerve or perhaps only one of its branches is damaged.

From a practical point of view, we may confine our thoughts to the following: Unilateral abductor paralysis is most frequently found. The paralyzed cord stays in the midline and the normal cord moves well. (Fig. 5B.) If the paralyzed cord does not quite meet the midline, the normal cord may compensate by going past the midline to meet the other cord. The condition may therefore be symptomless and be entirely overlooked. Almost always there is sufficient breathing space although occasionally the patient may complain of dyspnea on exertion. Pharyngitis is a frequent complication. The prognosis is excellent and surgical treatment is rarely indicated.

Bilateral abductor paralysis is much more serious and may even be a calamity. Lahey[16] states that the cords immediately assume the cadaveric position. (Fig. 5C.) In this the cords are slightly curved and flaccid. There is usually ample room for breathing but the cords are separated so widely that phonation is impossible. Later, as fibrosis occurs, the cords are drawn together and the patient may gleefully

TABLE I

CAUSES OF PARALYSIS OF THE VOCAL CORDS

Traumatic	To the nerve in any part of its course
Neurosis	Hysteria
	Laryngeal spasms of neurologic origin
	Adductor spasm
	Incoordination
	Intermittent or abductor paralysis
Miscellaneous	Tabes
	Disseminated sclerosis
	Bulbar disease
	Syringomyelia
	Poliomyelitis
	Neuritis of the nerve itself
	Myasthenia gravis
	Diabetes
Pressure on nerve	Tumors (malignant or benign)—Thymoma
	Neurofibroma
	Carot'd body tumor
	Branchial cyst
	Cancer of esophagus
	Tuberculosis (lymph nodes in neck or chest)—Pleuritis
	Syphilis
	Hematoma
	Goiter (cervical or thoracic)
	Aneurysm (in neck or thorax)
	Adenopathies—Lymphatic leukemia
	Hodgkin's disease
	Thickened pleura
	Pericardial effusion
	Pericarditis
	Dilatation of left auricle
	Tumor in 4th ventricle (medulla)
Toxic poisons	Vegetable (alcohol or tobacco)
	Metallic (lead, mercury, bismuth, copper, silver)
	Systemic infection—Diphtheria
	Pneumonia
	Influenza
	Typhus
	Erysipelas
	Ptomaine poisoning
	Serum disease
	Botulism
Adhesions in the neck	Thyroiditis
	Postoperative
Operative	A. Stretching the nerve or pressure
	Ligating the nerve
	Cutting the nerve
	B. Presence of anomalies of the anatomy, particularly of the nerve itself (see illustrations)

tell the doctor that her voice is coming back. However, should this proceed to a further degree, the air space is inhibited and dyspnea may supervene. This may make tracheotomy a necessity. In the intermediate stage some patients learn to breathe deeply and slowly and to curtail their physical activities. Most patients require surgery sooner or later.

Jackson[15] states that a large number of these cases assume the midline position immediately and the patients have great dyspnea and stridor, requiring immediate tracheotomy. Some of these cases, while first assuming the midline position, later develop the cadaveric position. The author believes that severe stridor and dyspnea occur frequently. Two thyroidectomies performed by other surgeons were observed recently and both required tracheotomy within a few days of surgery. King[11] states that when the cords are in adduction, tracheotomy is necessary at once.

The position which the cords assume is probably due to differences in the nerves involved. The whole nerve produces complete paralysis and the cords are most likely to assume the cadaveric position. If both the posterior branches of the recurrent nerve are damaged, the cords are abducted and widely separated (as the adductor is paralyzed). This is a rather rare condition. If both the anterior branches are affected, the cords will be adducted, i.e., cords are close together. Immediate tracheotomy is necessary. When the superior laryngeal nerve is affected, the cricothyroid is paralyzed. This is the most important tensor of the cords. The cord or cords are rather loose and tend to wrinkle. The internal tensors, i.e., thyroarytenoids (supplied by the recurrent nerve), play a lesser role. When they are also paralyzed, they cause an increase in the looseness of the cords. The voice is hoarse, somewhat weak and tires easily. There is no definite surgical treatment. There is often spontaneous recovery.

The prognosis is important. A high percentage will recover without surgery. King[11] states that when one of the two branches is injured recovery is impossible and the ones most likely to show improvement are those where the whole nerve is involved. If recovery is taking place, improvement should be noticed before three months. If after six months there is no improvement, recovery is impossible since fibrosis of the joints takes place.

There is a wide and varying degree of recovery since there is a high compensatory mechanism in the larynx for both respiration and phonation, resulting in many bizarre pictures. Some cases of bilateral abductor paralyses may have both cords near the midline but can still breathe well due to the cords being uneven (one higher than the other), i.e., in different planes. The tensor action of the cricothyroids brings the cords closer together for phonation. Even after successful operation the results will vary depending upon the will of the patient. Speech- and voice-training programs often yield great improvement.

TREATMENT

When paralysis is unilateral, no surgical treatment is necessary. There is no case, however, which requires more tact and diplomacy. The patient should be told frankly what the condition is and be brought in for frequent inspections and encouragement. She should be told that many cases recover spontaneously; and also that if this does not occur, she will have a good functional voice and breathing space. Often pharyngitis and laryngitis have to be treated.

When bilateral abductor paralysis is present, the condition is much more serious. Even some of these recover. Immediately after surgery tracheotomy may be necessary if the cords are so close together that dyspnea is pronounced. In these the cords will be 2 mm. or less apart. Where the cords are more than 3 mm. apart, it is possible to temporize to see if spontaneous improvement occurs. In some cases there will be cicatricial contraction which draws the cords closer to the midline. If this process does not proceed too far, some patients may get along. Phonation is possible and they have enough room to breathe. The principal indication for surgery is dyspnea. The goal is to make breathing adequate for the physical requirements and at the same time allow the patient to phonate.

Jackson[15] removed portions of the cords endoscopically. Some operations were successful while others were not clinically satisfactory. Hoover[17] removed portions of the cords through a laryngeal fissure. Some improvement was obtained in many cases. Suture of the nerve has been tried by Lahey,[16] Frazier[9] and Ballance[10] but their attempts have been very disappointing.

King[8] was the first to attempt the extralaryngeal approach. At first he sutured the omohyoid to the arytenoid cartilage, hoping to pull the cord laterally. Later he worked out a new technic which has been eminently successful. The steps in the procedure are (1) disarticulation of the cricoarytenoid joint, (2) dissecting away the attachment of the interarytenoid muscles and (3) fixation of the arytenoid cartilage to the thyroid cartilage by a suture. The opening produced is checked by laryngeal visualization before the suture is tied. It is aimed to have a 5 mm. chink between the cords.

Woodman[12] modified the King operation by removing the arytenoid cartilage, leaving the vocal process. The latter is drawn outward by a silk suture and fastened to the thyroid cartilage. Morrison's[20] modification of the King operation is chiefly that he uses two sutures, believing that this prevents tilting of the thyroid cartilage. Kelly[12] opens a window in the thyroid cartilage and sutures the cord laterally after removing the arytenoid cartilage. Thornell[21] removes the arytenoid cartilage through a laryngoscope, using the Lynch suspension apparatus. He then cauterizes through the same wounds. He finds that the cords open by the production of cicatricial contraction. This method will have to be followed longer before it can be properly evaluated.

In cases of adductor paralysis a "reverse King operation" is indicated. In this case the arytenoid cartilages are brought closer together by sutures.

Whatever method is used, voice culture and training are of the utmost importance. Great improvement can be expected from this invaluable adjunct to surgery.

COMMENTS

We wish to emphasize again that paralysis following thyroidectomy must not be construed always as a severance of the nerve. It has been shown that there are many other ways by which a nerve may be injured. Goiter alone may be a cause. Pressure and fibrosis associated with thyroiditis, scar tissue following surgery and malignancy all may cause paralysis entirely apart from surgery. The nerve itself is very sensitive and may be traumatized during surgery. The nerve, too, runs a very peculiar course. Dipping as it does down into the thorax, it may be subject to insult in any area of its long course. Then, too, the nerve has anomalies which make it more liable to injury. Certainly, injury to the nerve is a natural hazard in this type of surgery.

It would safeguard us to have careful preoperative examinations. This is not routine for most surgeons but in my opinion it is advisable for our protection. A careful history is important and may reveal a story of a severe cold with hoarseness which persisted. This often means that paralysis had spontaneously occurred at that time. Careful histories in the hospital are essential. We had one unilateral paralysis recently and the operative record showed that the nerve had been visualized and checked at the termination of the operation and was seen to be intact throughout its full length in the neck. The patient has been somewhat difficult to handle but with this safeguard I am much relieved. Histories should record the voice, dyspnea and other difficulties after surgery.

Surgeons should, however, recognize that thyroidectomy is a serious procedure and should take every precaution to prevent damage to the nerve. Whether we should follow Lahey[2] in exposing the nerve in all cases preliminary to thyroidectomy is a moot question. I may say that in our cases we do expose the nerve in most of the patients but do not do so in every case. Certainly the rule is not universal and the surgeon who fails to do so is definitely not to be condemned from a medicolegal point of view. In any case, careful hemostasis is essential. The delicate handling of the tissues is mandatory.

In the treatment of paralyses the Laszlo-Fiertz[14] electrical test and electrical therapy seem to offer an interesting addition to our facilities. However, its use as yet has not become widespread and has not been fully accepted by the profession.

This type of case requires the use of extreme tact and patience. It would be best to tell the patient preoperatively that the natural hazard of thyroidectomy is paralysis. After thyroidectomy a frank talk with the patient informing her of the complication and the plan of treatment often keeps the patient under control. If this is not done, she will see some other doctor who may not be so tactful and either by word or deed insinuate that the surgeon cut the nerve. This certainly is not always the case,

as we have shown. It is remarkable how many lawsuits are started by the second doctor making an unwise remark.

SUMMARY

1. The causes of paralyses of the vocal cords, their clinical manifestations and treatment are discussed.

2. It is emphasized that paralysis does not always mean a cutting of the nerve.

3. The anatomy and pathology are reviewed and illustrated by suitable sketches.

4. Methods of prevention of paralysis during surgery are discussed.

5. Suggestions are made for the handling of these cases which may safeguard the surgeon against medicolegal suits.

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MANAGEMENT OF THORACOABDOMINAL INJURIES AT A MOBILE ARMY SURGICAL HOSPITAL LEVEL IN KOREA*

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THIS presentation deals with the principles and methods applied in the diagnosis and treatment of thoracoabdominal injuries at the Mobile Army Surgical Hospital, 8076 Army Unit.

Penetrating or perforating missile wounds may lead to thoracic, thoracoabdominal and to independent thoracic with independent abdominal wounds on the same patient.

The management of the thoracic injuries has been presented in detail elsewhere.[1]

Thoracoabdominal injuries are greater emergencies than chest injuries alone. The delay for surgical intervention is limited to the time needed for resuscitation and complete evaluation of the pathologic condition. Careful inspection of the wound or wounds establishes the nature of the injury, which is substantiated by physical examination, and postero-anterior and lateral x-rays of the chest and abdomen. Evidence of retained intraperitoneal metallic foreign body is an absolute indication for laparotomy. Perforation of the diaphragm or the anatomic likelihood of such is also an indication for laparotomy rather than for thoracotomy.[1,2] In cases of massive hemothorax the pleural space is aspirated and, if present, the sucking wound is handled prior to laparotomy. The abdomen is opened through a right or left paramedian or mid-rectus incision, which frequently extends up to the costal arch. The diaphragmatic perforations are closed from below with No. 1 silk mattress sutures while the contents of the pleural space are aspirated with a thoracotomy tube which is inserted into the pleural space through the diaphragmatic tear. The tube is removed while the last stitch of the diaphragm is tied and the lung is kept inflated at the same time. In the case in which a hollow viscus of the abdomen is perforated, the pleural space is irrigated with saline prior to closure of the tear of the diaphragm; and at times a thoracotomy tube is also inserted into the pleural space in a dependent position. The abdominal cavity is carefully surveyed and the injuries corrected. The small bowel perforations are closed in two layers. Extensive segmental destruction or multiple perforations within a given segment of the small bowel necessitate resection, and end-to-end anastomosis is accomplished in two layers. Large bowel perforations are handled by exteriorization, or by resection if large segments are destroyed, and the ends are brought out through separate stab wounds of the abdominal wall. In cases of right colon destruction, right colectomy and ileotransverse colostomy is the procedure of choice. Liver wounds are controlled with No. 1 chromic mattress sutures with the bites placed at least 1½ or 2 cm. apart. A Penrose drain is placed over the wounded liver surface and brought out through a stab wound at the right flank. The abdominal wall is closed with through and through wire sutures in addition to segmental continuous No. 1 chromic sutures for the peritoneum.

Only a few of the thoracoabdominal injuries need be submitted to abdominothoracic exploration. These are those upper abdominal and lower thoracic injuries which are not accessible through laparotomy wounds alone, such as some of the liver wounds located at the dome of the right lobe near the vena cava inferior, a few of the otherwise inaccessible diaphragmatic tears like those near the vena cava, and injuries to the lower end of the esophagus and cardiac end of the stomach. These indications are in addition to the patients who need open thoracotomy primarily,[1] followed by exploration of the abdominal cavity.

The author's approach for abdominothoracic exploration is described in detail in another publication[2] and briefly is as follows: A paramedian or mid-rectus right or left laparotomy

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incision is made. If the intra-abdominal findings establish the indication for abdominothoracic exploration, the operative wound is extended upward over the seventh, sixth, fifth and sometimes the fourth cartilages which are divided at a point about ¾ inch lateral to the sternal margin. If needed a lateral extension is made within the fifth or fourth intercostal space up to the mid-axillary line. If it is necessary for better exposure, the diaphragm is also divided. In most of the cases there is no indication for lateral extension of the incision. In those cases in which the thoracoabdominal injuries present the absolute indications for open thoracotomy, this procedure is started as an anterior thoracotomy and then the incision is extended downward over the costal arch to the abdomen.

The independent chest and independent abdominal injuries on the same patient frequently result from multiple shell fragment wounds. They present no particular problems as long as the chest injury is taken care of first followed by laparotomy. The aspiration of a hemothorax or closure of the sucking wound of the chest enables the patient to endure an abdominal exploration with greater safety.

PRE- AND POSTOPERATIVE CARE

Resuscitation starts as soon as the casualty is admitted. The patient is placed in the Trendelenburg position and blood transfusion is started, if needed, via the arterial route. One gram of streptomycin and one million units of penicillin are given with the transfusion. The wounds are carefully inspected and dressed. When the blood pressure becomes stabilized at a minimum of 80 systolic level, a chest x-ray is taken for the purpose of estimating the thoracic phase of the injury. If the abdominal injury is not obvious on physical examination, postero-anterior and lateral abdominal x-rays are also taken for careful localization of the retained metallic foreign body or for the purpose of reconstruction of the missile tract. For this reason, in cases of perforating wounds coins are strapped over the wounds prior to the x-ray studies. The patient is taken to the operating room with a Levin tube in place, and adequate channels are kept open for continued blood transfusion. During the postoperative period the patient receives ½ gm. of streptomycin twice a day and 600,000 units of penicillin intramuscularly four times a day during the entire period of hospitalization. The airways are kept free of secretion and blood by encouraging coughing, expectoration and, if needed, by bronchial catheterization or bronchoscopic suction. Efforts are made to maintain the re-expanded state of the injured lung, already accomplished in the operating room. The gastrointestinal tract is kept decompressed by Wangensteen suction for a varied period of time, depending on the type and location of the intra-abdominal injury. The patients are ambulated early unless this is prevented by associated extremity wounds, and they are evacuated seven to ten days following admission.

CASE REPORTS

Case 1. R. C., a twenty year old American soldier, sustained thoracoabdominal perforating bullet wounds. At the time of admission he was in shock, vomiting blood and his abdomen was rigid. The entrance wound measured about 1 by 1½ cm. and was located at about the eleventh rib at the posterior axillary line on the left. The sucking exit wound measured about 4 by 2 cm. at about the fourth intercostal space and costochondral junction on the right. Chest x-ray revealed no obvious evidence of hemothorax or pneumothorax.

After the patient was given 1,000 cc. of blood, the right sucking wound was débrided under general endotracheal anesthesia and about 2 cm. of cartilage were removed, the pleural space aspirated and the wound closed up to skin level with interrupted No. 00 chromic sutures. Laparotomy was then performed through a left paramedian incision. The findings were as follows: perforation of the lateral aspect of the left diaphragm, laceration of the spleen, tangential perforation of the posterior wall of the stomach near the lesser curvature at about its mid-part, large hematoma of the gastrocolic ligament with arterial bleeding, an orange-sized hematoma of the omentum, perforation of the right lobe of the liver just right of the falciform ligament (about 4 cm. long), perforation of the right leaf of the diaphragm just to the right of the falciform ligament, bilateral hemopneumothorax and large hemoperitoneum. Splenectomy was performed followed by closure of the perforation of the left diaphragm while the left pleural space was being aspirated through

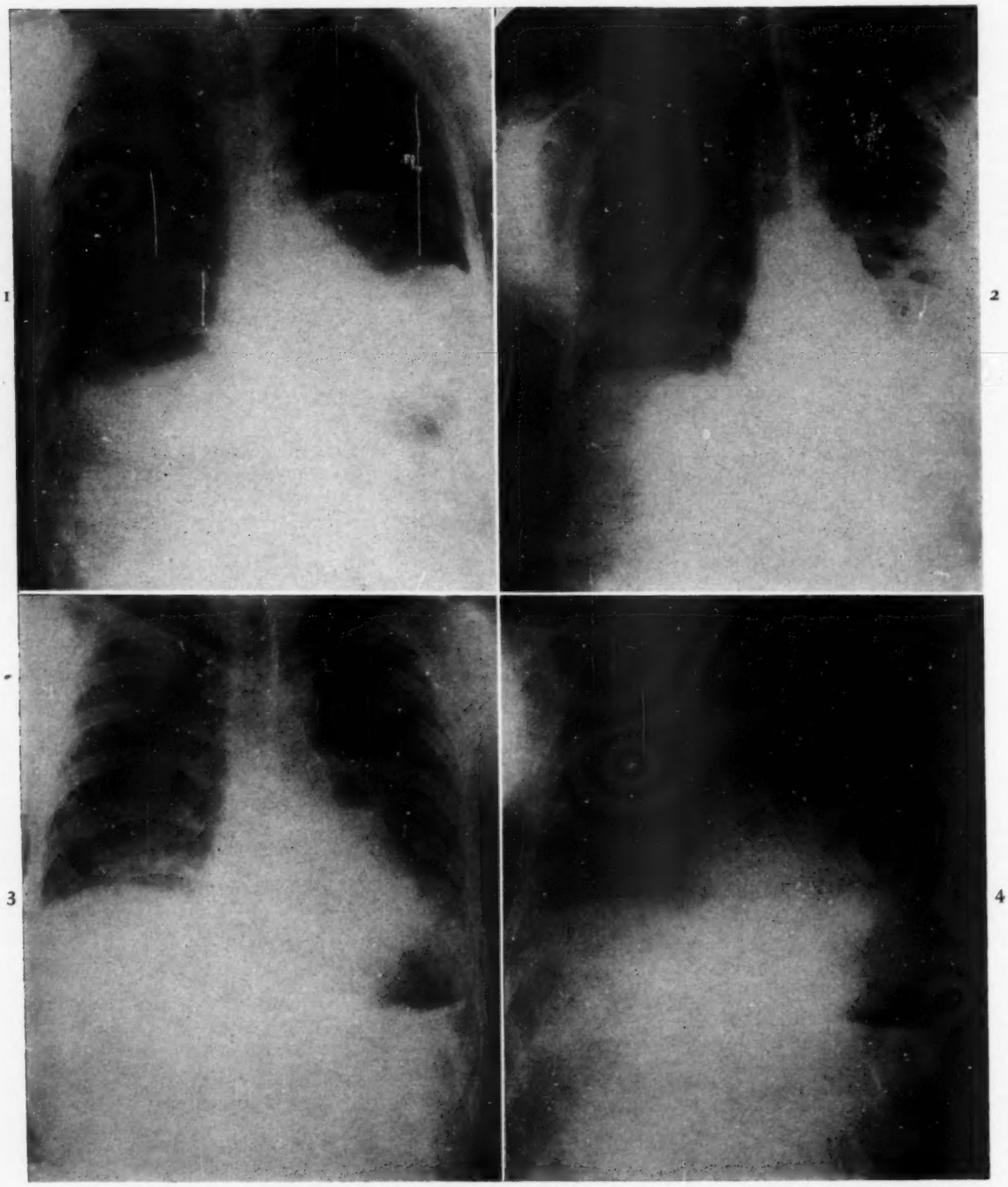

FIG. 1. Almost complete collapse of the left lung. FIG. 2. The left lung is fully expanded. FIG. 3. The lungs are well expanded. The heart shadow is increased and shows evidence of hydropneumopericardium. FIG. 4. Evidence of only minimal clouding at the left base.

5 6

FIG. 5. Blurring of the left lung field and evidence of metallic foreign body within the right chest.

FIG. 6. Lateral view places the metallic foreign body anteriorly within the right chest.

the rent in the diaphragm. The perforation of the stomach was closed in two layers. The arterial bleeder of the gastrocolic ligament was ligated. The perforation of the right diaphragm was closed while the pleural space was aspirated. The distal third of the omentum was resected. Two Penrose drains were placed to the area of the lacerated liver and brought out through a stab wound at the right flank. The abdominal wound was closed with through and through wire sutures. The patient also had a compound comminuted fracture of the lower third of the radius with severed radial artery and multiple severed tendons. The arm wound was débrided and a long arm cast was applied.

The next day the left lung was found almost completely collapsed (Fig. 1) with plus 8, plus 4 intrapleural readings. The pleural space was deflated with the help of a suction machine, resulting in complete lung re-expansion. (Fig. 2.) On the second postoperative day x-ray (Fig. 3) showed both lungs well expanded with the heart shadow increased and fluid level within the pericardial shadow, suggesting hydropneumopericardium which cleared spontaneously during the next two days. The patient's progress was excellent. He tolerated soft diet well, had spontaneous bowel movement and the drainage from the area of the Penrose drains lessened considerably.

On the seventh postoperative day there was a distinct change in the patient's condition. The temperature was 101.6°F., pulse 120 per minute, respiration 32 per minute and the stool was dark red. The hemoglobin was 9.5 gm., later 7.2 gm.; and after 1,000 cc. of whole blood were given, it was 8 gm. and the hematocrit was 25 per cent. The patient's skin was icteric and he was in marked respiratory distress, expectorating bile-stained sputum in large quantities. The bile drainage around the stab wound of the Penrose drain was considerable. Aspiration of the stomach revealed dark blood. The hemorrhage in the gastrointestinal tract was treated conservatively. The patient received 4,000 cc. of blood within forty-eight hours, with resulting control of hemorrhage and marked improvement in his general condition. The wounds remained clean. Bile drainage through the abdominal stab wound continued to be profuse and the color of the skin cleared. The expectoration of bile-stained material stopped. The lung fields were clear with the exception of minimal clouding at the left base. (Fig. 4.) Thirteen days following his admission and three days after the hemorrhage

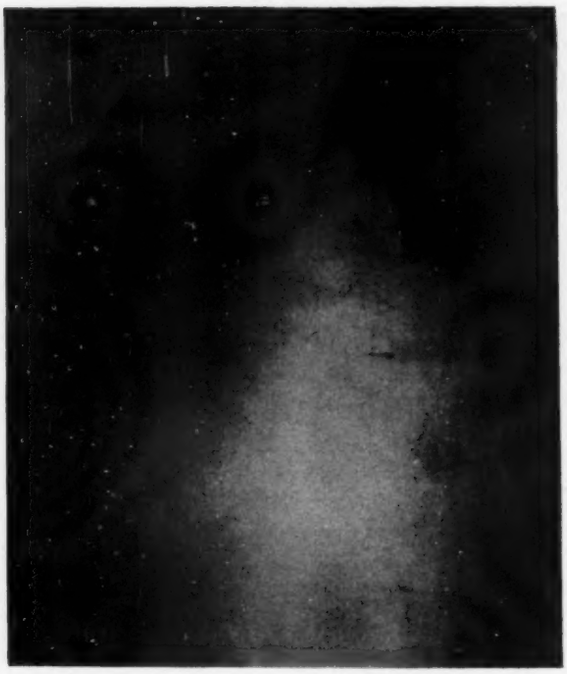

FIG. 7. Both lung fields are clear. The heart shadow is widened.

in the gastrointestinal tract was controlled, the patient was evacuated in good general condition.

Comment. This case is an example of a thoracoabdominal injury with sucking chest wound on the right and perforation of both leaves of the diaphragm managed by laparotomy. One of the several interesting features of this case is the blast effect of the bullet on the heart causing hydropneumopericardium (hemopneumoperiçardium) which cleared spontaneously.

CASE II. A. A., a twenty-five year old soldier, was admitted seven hours after he was wounded. At the time of his admission he had marked respiratory distress and was in shock. There was a 3 by 1 cm. bleeding and sucking wound over the left chest wall at about the sixth intercostal space and parascapular line in addition to multiple shell fragment wounds of his right flank and buttocks. X-rays of the chest showed almost complete blurring of the left lung field with a large metallic foreign body lodged anteriorly within the right chest. (Figs. 5 and 6.)

Under general endotracheal anesthesia the sucking chest wound was débrided and 700 cc. blood aspirated from the pleural space. This was done with the help of a thoracotomy tube which was inserted through the chest opening and removed when the last suture was tied, during the process of closing the sucking wound up to skin level. Laparotomy was performed through a left rectus incision. The findings were as follows: double perforation of the left leaf of the diaphragm, one about 5 by 2 cm. in its lateral aspect and one 2½ by 1 cm. near the margin of the right diaphragm, with half of the tear extending into the right diaphragm making a communication between the two pleural spaces and peritoneal cavity; double perforation of the anterior wall of the stomach, each about 5 by 3 cm.; perforating wounds of the left lobe of the liver, none of them bleeding; massive hemothorax on the left; large hemoperitoneum; and a metallic foreign body lodged within the parietal pleura of the right anterior chest wall.

The diaphragmatic tears were closed with No. 1 black silk mattress sutures while both pleural spaces were evacuated and irrigated with normal saline, with the help of a thoracotomy tube inserted through the diaphragmatic perforations. Three bony fragments of ribs were also removed from the left pleural space, and a metallic foreign body measuring about 1½ by 2 cm. was removed from the right pleural space through the diaphragmatic opening. The stomach perforations were closed in two layers. Two Penrose drains were inserted to the wounds of the liver and brought out through a stab wound at the right flank. The peritoneal cavity was evacuated. The intestinal tract was inspected and the operative wound was closed with through and through wire sutures. A thoracotomy tube was inserted into the left pleural space at about the sixth intercostal space and anterior axillary line. On the third postoperative day the thoracotomy tube was removed and bronchial catheterization applied for right upper lobe atelectasis, with resulting complete clearing of the lung field within one day. The patient made a good recovery. The wounds were clean and healing, both lungs were well expanded and the lung fields were clear on x-ray (Fig. 7) taken on the day of evacuation, nine days postoperatively.

Comment. This is an example of thoracoabdominal injury with perforation of both leaves of the diaphragm handled from the abdominal side.

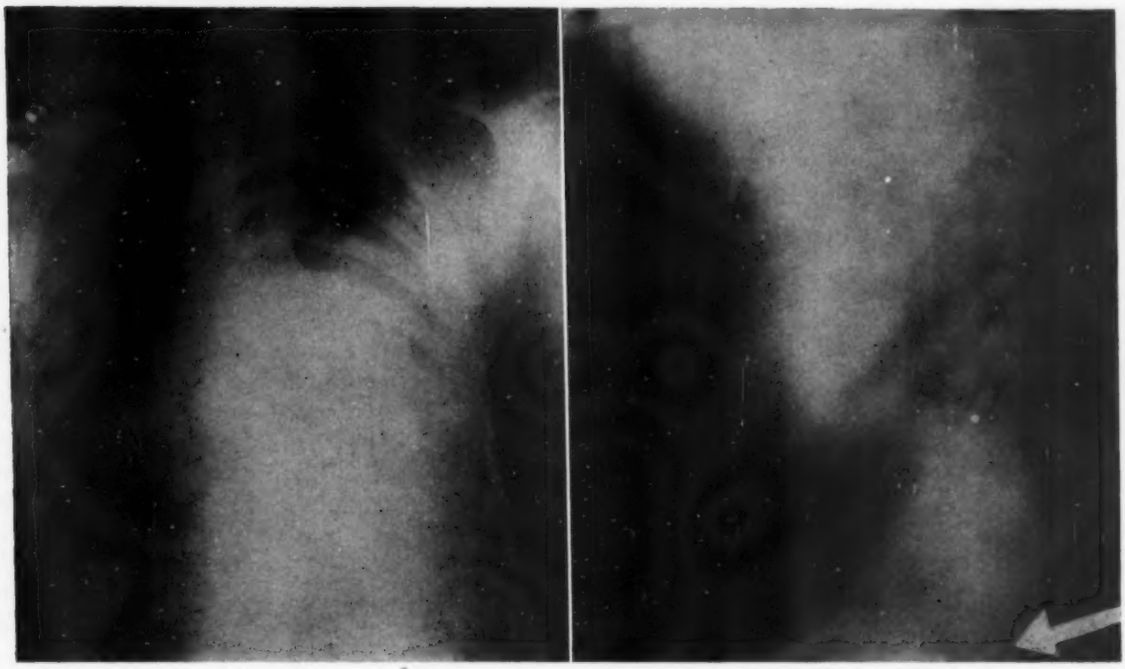

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FIG. 8. Hemothorax on the right side; the bullet is located on the left side. (This film was reversed when print was made.) FIG. 9. Lateral view places the bullet posteriorly.

CASE III. S. J., a twenty year old American soldier, was admitted six hours after he was wounded. He sustained a penetrating thoracoabdominal bullet wound. At the time of admission he complained of right chest pain and expectorated blood. His general condition was fairly good. The entrance wound was located at about the first intercostal space and anterior axillary line on the right, and measured about 1 cm. in diameter. Postero-anterior and lateral chest x-rays (Figs. 8 and 9) revealed hemothorax on the right and the bullet lodged on the left side, posterolaterally at the level of the twelfth rib.

The patient was submitted to a laparotomy through a right paramedian incision which was extended upward primarily for the purpose of gaining better exposure of the torn liver and diaphragm. The seventh, sixth, fifth and fourth cartilages were divided. The findings were as follows: large hemothorax; through and through perforation of the right middle lobe with active bleeding from what appeared to be one of its segmental veins; 3 cm. hematoma of the anterior margin of the right lower lobe; 2½ by 2½ cm. tear of the right diaphragm just to the right of the vena cava inferior; laceration of the posterior aspect of the dome of the liver measuring about 6 by 4½ cm., bleeding profusely; massive retroperitoneal hematoma at about the splenic flexure of the colon; perforating wound of the left kidney with massive laceration of its pelvis; and large hemoperitoneum.

The liver wound was controlled by No. 1 chromic mattress sutures. A left nephrectomy was performed. The bleeding vein of the right middle lobe was ligated. The perforating lung wounds were débrided and closed with No. 00 chromic sutures. A large amount of liquid and clotted blood was removed from the pleural space. The diaphragmatic tear was closed with No. 1 silk mattress sutures. The pleural cavity was irrigated with saline and two thoracotomy tubes were inserted into the pleural space. After the exploration of the retroperitoneal space and careful inspection of the entire intestinal tract Penrose drains were placed to the sutured liver laceration and brought out through a stab wound at the right flank. This was followed by closure of the thoracoabdominal wound in layers. The entrance wound was débrided.

The patient made a good recovery. Four days following his operation he was up and about. The wounds were clean and healing and

FIG. 10. The right lung is fully expanded. There is evidence of parenchymal clouding at the site of the repaired lung injury. The bullet is located on the left side. (This film was reversed when print was made.)

the lung was fully re-expanded, showing only parenchymal clouding at the site of the repaired right lung injury at the time of his evacuation. (Fig. 10.)

Comment. In this thoracoabdominal injury the location of the liver wound and the site of the diaphragmatic tear were the indications for the abdominothoracic exploration.

CASE IV. A. L. F., an American soldier, was wounded four hours prior to his admission and sustained perforating thoracoabdominal bullet wounds. At the time of admission, he was in shock and had no perceptible blood pressure or pulse. Examination revealed the ¾ cm. entrance wound at the right flank and the 2 cm exit wound over the right anterior chest wall at about the fifth intercostal space and mid-clavicular line. By the time the patient received 2,500 cc. blood his blood pressure was 124/80 and the pulse was 100 per minute. X-ray (Fig. 11) of the chest showed massive hemothorax on the right. The abdomen was rigid to palpation. The patient was submitted to an abdominothoracic exploration with the following findings: "liver fracture" consisting of massive star-like laceration of the dome of the liver with a radius of about 6 cm., bleeding profusely; extensive retroperitoneal hemorrhage with three perforations of the lower part of the ascending colon and cecum; peritonitis; a 5 cm. tear of the anterior aspect of the right leaf of the diaphragm; massive right hemothorax with blast injury to the right middle lobe (hematoma); and fracture of the fourth cartilage. The exploration was started with a right mid-rectus laparotomy incision; and as soon as the extent and location of the liver injury was realized, the operative wound was extended upward dividing the seventh, sixth, fifth and fourth cartilages. An excellent exposure of the right thoracic and abdominal cavities was obtained. The liver wound was repaired with No. 1 chromic mattress sutures and the diaphragmatic tear was approximated with No. 1 silk mattress sutures. The retroperitoneal space was explored. The perforated cecum and lower part of the ascending colon were exteriorized through a right lower quadrant muscle-splitting incision. The pleural space was irrigated with saline and a thoracotomy tube was inserted in a dependent position. The chest part of the wound was closed in layers. Two cigarette drains were placed to the dome of the liver and brought out through a stab wound at the right flank. The abdominal part of the wound was closed with through and through wire sutures and No. 1 chromic segmental continuous sutures for the peritoneum. The entrance and exit wounds of the bullet were débrided. Two days later x-ray (Fig. 12) showed evidence of full lung re-expansion and a round area of density within the lower lung field, representing pulmonary hematoma. The abdomen was soft and the colostomy (exteriorized cecum) was patent, but the abdomen remained silent. The adynamic ileus continued unchanged and the patient died on the seventh postoperative day.

Comment. Massive liver wound and its location was the indication in this case for the abdominothoracic exploration.

CASE V. C. R. M., a twenty-three year old American soldier, was wounded in action and sustained a perforating thoracoabdominal bullet wound on the left side. The entrance wound was located at about the fifth intercostal space and anterior axillary line, and the exit wound at the tenth intercostal space near the transverse process on the left side. The abdomen was tender to palpation and muscle spasm

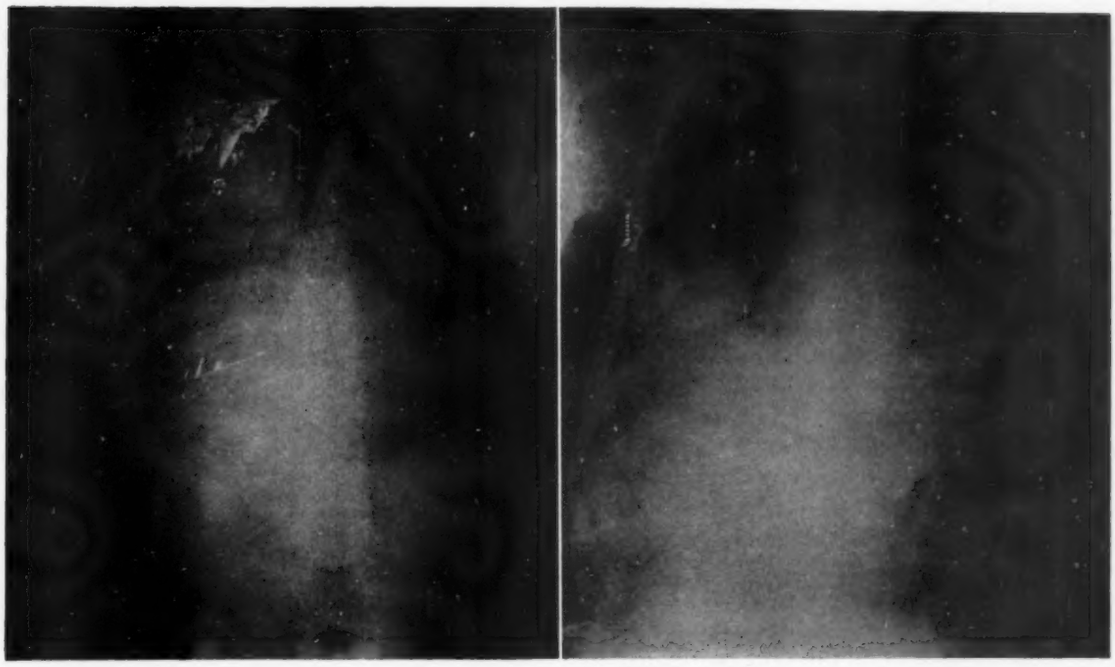

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FIG. 11. Massive hemothorax on the right side. FIG. 12. The right lung is fully expanded. There is evidence of a round area of density within the lower lung field representing pulmonary hematoma.

was present. Chest x-ray revealed the lung fields grossly normal in appearance.

The patient was submitted to laparotomy through a left paramedian incision. The intra-abdominal findings were as follows: ruptured spleen; ruptured left kidney; double perforation of the left leaf of the diaphragm with one near the costal arch (lateral) and one near the aorta; and large hemoperitoneum. Splenectomy and left nephrectomy were performed and the lateral diaphragmatic tear was closed with No. 1 silk mattress sutures. At this stage of the operation, although the pleural space was previously aspirated through the already repaired lateral diaphragmatic tear, considerable active bleeding was noted coming from the chest. The laparotomy wound was extended upward and the seventh, sixth and fifth cartilages were divided; the diaphragm was split in anteroposterior direction. An excellent exposure of the left pleural space was obtained with the following findings: a small tear of the lateral edge of the lingula with hematoma within the lung; fracture of the fifth rib at mid-axillary line and the tenth rib near its transverse process; torn and bleeding, the tenth intercostal artery near its origin; and large hemothorax. The torn intercostal artery was ligated. The pleural space was evacuated and irrigated, and two thoracotomy tubes were inserted for underwater drainage. The diaphragm was approximated with No. 1 silk mattress sutures. The chest part of the wound was closed in layers, and the abdominal part with through and through wire sutures in addition to No. 1 chromic segmental continuous sutures for the peritoneum.

The patient made an uneventful recovery. On the eighth postoperative day, at the time of his evacuation, x-ray of the chest showed no abnormalities. He was ambulatory, tolerating a general diet well and the wounds were clean and healing.

Comment. In this case the unexplained active bleeding coming from the chest made it necessary to extend the laparotomy to an abdominothoracic exploration.

REMARKS

It is not the purpose of this publication to discuss the treatment of abdominal injuries as such. The standard methods of management of the wounds of the stomach, small and large bowel, liver, kidney and spleen were mentioned only in relation to the combined thoracoabdominal wounds. Contrary to the

writings during and after the second World War,[3,6] perforation of the diaphragm or its anotomic likelihood is not found to be an indication for open thoracotomy. These patients are better handled by laparotomy, and in the rare instances when open thoracotomy is indicated as well, by abdominothoracic exploration. Through a thoracotomy incision the diaphragm can be repaired easily, but the surveying of the intra-abdominal organs cannot be complete even if the thoracotomy incision is placed low and the diaphragm is split. This is particularly the situation on the right side. The procedure of choice is laparotomy and repair of the diaphragmatic tear from below as outlined previously. This approach gives a chance for a thorough and complete examination of the gastrointestinal tract, evacuation and elimination of the pleural space, and establishment of complete lung re-expansion. In those few cases in which abdominothoracic exploration is necessary, the anterior approach is found to be easy and quick to do. It gives excellent exposure and the wound heals well. A meticulous layer closure of the chest part of the incision is accomplished. The abdominal part of the operative wound is closed as any other laparotomy incision with through and through wire sutures.

SUMMARY

Methods of diagnosis and treatment of thoracoabdominal injuries at a Mobile Army Surgical Hospital level are presented.

The fact is emphasized that perforation of the diaphragm or its anatomic likelihood is not an indication for thoracotomy. The distinct value of laparotomy in contrast to thoracotomy in the management of thoracoabdominal wounds is stressed. Illustrative cases are presented.

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PENETRATING WOUNDS OF THE CHEST*

REVIEW OF 251 CASES

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PENETRATING wounds of the chest may be produced by a variety of instruments available to the civilian population of the United States and are, therefore, of interest not only to the thoracic and general surgeon but also to the general practitioner as well.

Few reports have been published in recent years on the treatment of injuries to the chest encountered in civilian practice and at least one of these,[7] contrary to the general opinions found in the literature today, indicates that the authors do not usually aspirate an associated hemothorax.

Many good articles were published during and shortly after World War II on the treatment of war wounds of the chest. Among these is one by Dolly and Brewer[1] which contains an excellent discussion of the altered physiology of the lungs in chest injuries. Samson and his associates[2,3] give an excellent report on the treatment of war wounds of the thorax. Johnson[4] reports a series of 308 battle wounds in the Pacific theater with a mortality, from the chest wounds, of only 2 per cent. Harkins[5] emphasizes the importance of remedial breathing exercises to hasten the re-expansion of the lung and to prevent constricting adhesions. Rogers and Holman[6] believe replacement of the aspirated fluid with air is important in treating hemothorax.

All of these reports concern themselves with the type of injury seen in war casualties which, because of the high velocity of the missiles producing them, the frequency of multiple wounds and the delay in definitive treatment, set them apart from the relatively simple penetrating wounds of the chest usually seen in civilian practice.

Churchill[8] in his report on the care of war wounds said, "It is no longer acceptable to hold that a patient with a penetrating chest wound is making satisfactory progress as long as empyema has not made itself manifest. The focus [of attention] has been changed from management of posttraumatic pleural infection to the preservation of the lung function. In the history of military surgery, this will stand out as one of the significant advances of World War II."

It is to aid us in moving closer to the goal set by Churchill[8] that we have reviewed the results obtained in 251 penetrating wounds of the chest seen at The John Gaston Hospital during the years 1946 to 1950, inclusive.

ANALYSIS OF CASES

Of these 251 patients there were 245 Negroes and 6 Caucasians. The ages ranged from twenty-two months to seventy-three years. The instruments or weapons producing the injuries are shown in Table I. It can be seen that

TABLE I
CAUSE OF INJURY

Pocket knife	136
Pistol or rifle bullet	73
Shotgun	3
Ice pick	36
Butcher knife	1
Two-tined kitchen fork	1
Screw driver	1
Total	251

by far the most frequent weapon was the "switch blade" knife. The findings on admission included shock, dyspnea, generalized pain in the chest, hemoptysis, pain localized to the area of the wound and, in many cases, no pain or discomfort. In these latter cases the patient came to the hospital only because of the wound in the skin.

RADIOLOGIC EXAMINATION

All but twenty-three of our patients showed radiologic evidence of hemothorax or pneumothorax, either on admission or within forty-

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eight hours. Fifteen of these twenty-three cases were gunshot wounds, an indication that the heat of the missile caused it to act as a sealing cautery. Seventeen patients had subcutaneous emphysema. In our series the presence of subcutaneous emphysema did not seem to complicate the treatment or prolong recovery of the patient. Fifty patients had radiologic evidence of pneumothorax without radiologic evidence of hemothorax, while fifty-six patients showed hemothorax without pneumothorax.

In connection with the radiologic examination it is important to mention that many of these patients did not show any evidence of either hemothorax or pneumothorax at the time of admission, but one or both conditions were found on later examinations. For this reason the chest x-ray is repeated the day following admission and failing to find hemothorax or pneumothorax at this time, the examination is again repeated forty-eight hours later.

PLAN OF MANAGEMENT

On admission to the emergency ward all patients were inspected for the presence of an open or sucking wound of the chest. If present this was immediately corrected by packing with petrolatum gauze or adhesive strapping. This closure of open or sucking wounds of the chest takes precedence over all other phases of treatment.

A postero-anterior roentgen ray film of the chest was made before admission to the surgical ward if the condition of the patient was such as to permit this without hazard to the patient. The information obtained from this film often directly influenced the further treatment of the patient. In some instances shock prevented the making of this film before admission, in which case a portable film was made with the patient propped in a sitting position in bed. On admission to the surgical ward tension pneumothorax, if present, was relieved by thoracentesis. As has been emphasized by Skinner et al.,[9] and others, it is futile to try to correct shock in the presence of either a sucking wound or an internal pneumothorax since these conditions produce a physiologic shock which is not related to circulating blood volume. While these other conditions were being corrected, shock therapy was instituted if shock was present or impending. Regarding this phase of the treatment it should be mentioned that many of the patients with knife wounds of the chest will show no evidence of shock on admission due to their excitement and, in many instances, as a result of their partial anesthesia from alcohol. Practically all of these patients, however, will exhibit a fall in blood pressure with profuse sweating and a fast pulse within an hour. For this reason we now usually give patients with penetrating wounds of the chest at least 250 ml. of plasma on admission to the surgical ward. In cases in which there is a significant blood loss this plasma is given only while blood is being typed and cross matched and not as a substitute for blood.

After shock is corrected or averted the lacerations are closed surgically. Many of the wounds seen in civilian practice require only a few skin sutures to close. Some, however, have such extensive lacerations of the pleura or lung as to require closure under positive pressure anesthesia. We believe that positive pressure anesthesia with endotracheal intubation is the only safe anesthetic in these latter cases.

All patients in this series were given either antibiotics or chemotherapeutics, and at the present time the antibiotics have replaced the chemotherapeutic drugs. However, in this group of patients the duration of the fever and the length of hospital stay did not seem to be affected by the type of drug given or the amount in which it was given. All patients also received tetanus antitoxin after a skin test for sensitivity. Most patients with gunshot wounds of the chest or knife wounds below the level of the fifth intercostal space received gastric suction with the Levin tube and Wangensteen apparatus. This has assured a reasonably empty stomach in those cases of concurrent perforation of an abdominal viscus, thus reducing soilage of the peritoneal cavity and facilitating abdominal operation. A large number of our patients who did not have a penetration of the peritoneal cavity complained of abdominal pain and exhibited abdominal distention, probably from irritation of blood on the diaphragm. These signs and symptoms were reduced and a differential diagnosis made more easily with the stomach kept empty by suction siphonage.

We believe the most important part of the definitive treatment of penetrating wounds of the chest is the early and repeated aspiration of fluid and air from the pleural cavity. Unless

the patient showed marked dyspnea or radiologic studies revealed nearly complete collapse of the lung, no thoracentesis was performed until twenty-four hours after injury. At this time fluid and air in the amount of 500 ml. were aspirated from the pleural cavity. We believe that more than 500 ml. of fluid and air should rarely be aspirated at any one time, but the aspiration may be repeated every two to three hours if necessary. The aspiration of greater amounts may produce a mediastinal shift leading to marked tachycardia, cardiac arrhythmia and even death in rare cases. For this reason the aspiration should be performed slowly and the patient observed for dyspnea, profuse sweating or dizziness, and any marked speeding of the pulse. Dyspnea or coughing is considered an indication to discontinue the aspiration. When all the fluid and air obtainable are fractionally removed, roentgen ray films are made at suitable intervals and the aspirations repeated as often as necessary to keep the pleural cavity dry and the lung expanded.

RESULTS

Of the 251 cases we have reviewed, eighty-four required no thoracentesis. These included the twenty-three patients with no evidence of hemothorax or pneumothorax and also sixty-one patients who had only a small pneumothorax which was absorbed within forty-eight hours. In this series there were 111 patients who required from one to five thoracenteses and fifty-two who required more than five aspirations. There were three patients who required the insertion of an intercostal catheter and constant drainage under a water trap because of internal tension pneumothorax. The average number of days in the hospital for the series was 14.4 and the average number of days with fever, six. Fever was judged to be present for any temperature reading over 98.6°F.

The criteria for discharge of the patients from our hospital are: (1) pleural cavity dry and lung 90 per cent re-expanded; (2) temperature normal (98.6°F.) for seventy-two hours; (3) general condition of the patient and condition of the wound satisfactory.

Complications

Empyema developed in only three of our patients. One patient did not come to the hospital until seven days after he was stabbed. Another did not have a thoracentesis performed until thirty-five days after he was admitted to the hospital, an oversight which cannot be explained. There was no unusual circumstance in the third case of empyema. It is of interest to note that one of the patients in whom empyema developed received both penicillin and sulfadiazine, one received sulfadiazine alone and one received penicillin only.

There were fifty-eight patients in whom a final follow-up was not available at this time. Of the remaining 193 patients, all but forty-nine (25.39 per cent) had complete re-expansion of the lung without visible evidence of pleural thickening, and three of these patients either left the hospital against advice or were transferred to another hospital before completion of treatment. Fifteen of the patients in this series (7.87 per cent) had marked pleural thickening and these included the three who did not complete treatment, thus only twelve (6.12 per cent) of the patients who completed treatment had significant pleural thickening and loss of pulmonary function. Although this is the principal hospital in this area treating Negro patients, none of the patients in this series had a decortication of the lung performed in this institution. This came as a surprise to us in our review of the cases and can be explained chiefly by the fact that most of these patients insist on leaving the hospital as soon as they are feeling well. Undoubtedly, fifteen of the patients would have benefited by decortication but in those cases in which it was recommended, the operation was refused. Two patients are included in this series who had a "chemical decortication" with streptokinase and streptodornase.® These two cases were included in a series previously reported by Carr and Robbins.[10]

Mortality

The over-all mortality for the 251 cases was twenty-five (10 per cent). However, twenty-one of these patients died within the first four hours after admission to the emergency ward due to severe blood loss or large laceration of the lungs, major vessels or heart. None of these twenty-one patients reached the operating room. Ten of these cases were complicated by wounds of the abdominal viscera or fractures. Of the four patients who died after definitive therapy could have been started, two died as a result of delay in the diagnosis of cardiac

tamponade. In both of these patients the laceration of the myocardium was sutured, but only after prolonged shock. The third patient died as a result of uremia following prolonged shock. His chest wound was complicated by a transection of the spinal cord at the level of the ninth thoracic segment. The fourth patient expired on the sixth day after admission and autopsy revealed fat emboli in the lungs and an infarction of the left kidney. The embolus was presumed to have arisen from the fractured left femur.

COMMENTS

Penetration of the pleura must be suspected in all cases of laceration of the chest wall or epigastrium. The patient may have no chest pain or dyspnea when he presents himself for treatment and may desire only local treatment of the wounds. Although the roentgen ray examination is of paramount importance in diagnosis of penetrating wounds of the chest, the diagnosis can frequently be made prior to roentgen ray examination. A history of hemoptysis or the presence of subcutaneous emphysema is almost conclusive evidence of penetration of the lung. A hyper-resonant percussion note and absence of breath sounds over the upper portion of the injured side of the chest are indicative of a pneumothorax. A dull percussion note with suppressed breath sounds along with decreased tactile fremitus are indicative of a hemothorax.

The physical signs may be misleading, however, and a roentgen ray examination of the chest with the patient in the upright position is important as soon as the condition of the patient will permit. It should be emphasized that the absence of evidence of a hemothorax or pneumothorax on the chest film shortly after injury does not preclude the possibility that a penetration of the pleural cavity and lung has occurred. We follow the practice of repeating the chest film on the day following admission. If this second film shows no hemothorax or pneumothorax but the size of the skin wound, the history of the type of weapon used to produce the injury, or the physical signs and symptoms heighten our suspicion of a penetrating wound, the chest film is repeated forty-eight hours after admission. In many of the cases in this series no radiologic evidence of hemothorax or pneumothorax was seen on admission, but such was found on subsequent examinations. Much harm may result if a patient with a laceration of the chest wall is assured, after suture of the laceration, that he will be all right and is released, permitting a clotted hemothorax to develop. One of our patients received such treatment elsewhere and was admitted to our hospital seven days later with 85 per cent collapse of the lung and fever of 103°F. The hemothorax was clotted. The patient received streptokinase and streptodornase in the pleural cavity and was discharged after thirty-five days of treatment with the pleural space obliterated but with obviously poor function of the lung.

A discussion of penetrating wounds of the chest would not be complete without mention of penetrating wounds of the heart. Many of the patients with penetrating wounds of the heart do not reach the hospital alive, or expire within a matter of minutes after arrival. However, enough of these patients can be restored to health to make the recognition of this injury important. It is of great importance to realize that a stab wound or gunshot wound in any portion of the chest, either anterior or posterior, or in the epigastrium may penetrate the heart. The classic picture presented by patients with cardiac tamponade is dusky cyanosis, distention of the neck veins, pulse pressure markedly narrowed, often to 10 mm. of mercury, even before the blood pressure falls to shock level, distant heart sounds and a pulse that is not as rapid as would be expected from the degree of shock. Of these classic signs the distention of the neck veins, even when the head and shoulders are elevated, is the thing that immediately separates these patients from others in shock. There is, however, a small group of patients who sustain a penetrating wound of the heart from an ice pick or the point of a narrow blade knife in whom there is a less striking picture. These patients may show only a shock-like blood pressure which does not respond to blood or plasma administration, a pulse that is not as rapid as would be anticipated from the degree of blood pressure fall and, in some instances, more pain and mental confusion than the injury seems to justify. Patients with this group of signs should be watched closely and all of them should have a fluoroscopic examination. The classic picture of cyanosis, lowered pulse pressure and distended neck veins will, in time, develop, but by that time the patient may have been in

shock so long that there will be permanent damage to the brain or kidneys. In the presence of cardiac tamponade fluoroscopic examination will show a reduction in the pulsation of the cardiac shadow which is diagnostic of the condition. The chest roentgenogram is worthless in diagnosis of cardiac tamponade. In the absence of immediately available fluoroscopic examination a careful attempt at aspiration of the pericardium may be made. Such aspiration may well sustain life until cardiac surgery can be performed. Our patients with cardiac tamponade are treated as follows: (1) nasal oxygen immediately; (2) plasma followed by whole blood as soon as possible; (3) immediate aspiration if condition is critical; (4) fluoroscopy; (5) if response to aspiration is temporary, surgical closure of the wound in the heart as soon as the operating room is ready.

Aspiration of the pericardium is performed while the operating room is being prepared if the condition of the patient seems to be worsening. In ice pick wounds of the heart and occasionally in knife wounds of the heart, if the picture of cardiac tamponade has developed slowly, one may be content with two or three aspirations without surgery; however, the postponement of surgery should be undertaken only with the greatest caution and observation of the patient must be continuous.

With our present knowledge of chest physiology and with the aid of the antibiotics and chemotherapeutics few patients with penetrating wounds of the chest, seen in civilian practice, expire as a result of their wounds. We must devote our attention to the reduction of morbidity and sequela by the prevention of the development of empyema or a rigid fibrous encasement of the lung. This is best done by early and repeated aspiration of the fluid and air from the pleural cavity. Decortication of the lung and chest wall should be carried out when significant deposition of organizing fibrin on the pleural surfaces reduces pulmonary function.

SUMMARY

1. The method of treatment and the results obtained in 251 penetrating wounds of the chest admitted to a general hospital in a five-year period have been presented.

2. In this group there were twenty-five deaths, twenty-one of these occurring within the first four hours after admission.

3. There were three cases of empyema in this series. All but twelve of the 193 cases followed had re-expansion of the lung with no evidence of significant pleural thickening or loss of lung function.

4. A brief review of the diagnosis and treatment of cardiac tamponade is given.

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BILE AND CONTRAST MEDIUM REFLUX INTO THE PANCREATIC DUCTS

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IT is commonly assumed that bile reflux into the pancreatic ducts leads to acute pancreatitis or pancreatic necrosis. There were three reasons for this assumption: (1) approximately 80 per cent of all cases of pancreatitis are accompanied with a disease of the gallbladder, usually gallstones; (2) the finding that bile is able to activate trypsin; (3) Opie's finding of an ampullary stone.

However, the common channel theory undoubtedly should be rejected for several reasons. (1) At present we know that bile is not an activator of trypsin (Thomas) and nearly any fluid injected into the pancreatic ducts can cause pancreatitis. Several times a pseudocyst of the pancreas was drained through the gallbladder which did not lead to any pathologic disorder. (2) Harms, and Dragstedt and co-workers found the pressure of the pancreatic juice to be higher than the pressure of the bile. Although Dragstedt emphasized the possibility of an open Santorini duct, one seldom finds biliary discoloration of the pancreatic duct; Guleke found it only three times in 411 cases of acute pancreatitis. (3) In many cases even the anatomic possibility is not given as there is no distinct ampullary cavity. Furthermore, several cases of pancreatitis have been reported in which the common bile duct opened separately into the duodenum, yet gallstones were also present.

In the last years the pancreatic duct often was visualized by cholangiography thus obviously supporting the common channel theory. Hicken and McAllister recently published a paper concerned with the reflux of contrast medium into the pancreatic duct and concluded, "Apparently the reflux of bile into the pancreatic ducts is a normal physiologic process and is seldom productive of inflammatory changes within the pancreas." These authors came to this conclusion as they found evidence of pancreatitis in only three cases of one hundred in which they could demonstrate a positive reflux phenomenon. Because I believe that this is a misconception, I would like to give another opinion which might lead to a better understanding of this tantalizing problem.

Westphal in 1936 was able to demonstrate that the sphincter of Oddi divides into two parts: (1) circular muscle fibers at the end of the papilla of Vater which contract on stimulation of the sympathetic nerves, and (2) muscle fibers in the medium and upper part which, eight-shaped, wind around both the pancreatic and the common bile ducts and which contract under vagus stimulation. There is sufficient evidence that pancreatic disease will be induced only under vagus stimulation. A few of those points recently were shown by McCleery and co-workers. Under vagal spasm no bile reflux is possible as both the pancreatic as well as the common bile ducts are obstructed and a stoppage of the secretions in the ducts occurs, leading to pancreatitis as well as being the cause of cholecystopathies.

Sympathetic spasm can produce a common channel if there is a formation of an ampulla of Vater. However, under such a condition we will find relaxation and widening of the biliary bladder and ducts, and hyper-resorption from the gallbladder thus preventing any bile reflux into the pancreas.

The third possibility is an atonic duct system. In thirteen of their one hundred cases Hicken and McAllister noted a reflux of the contrast medium from the duodenum since the common bile and pancreatic ducts had separate duodenal orifices. Such a reflux is possible only through an atonic papilla of Vater, and we have to assume that the operative procedure is the cause of such an atonia which allows the reflux of the contrast medium into the pancreatic ducts. Such a finding, however, can never prove a reflux of bile. During the time of an

atonic duct system no chances for the onset of pancreatitis are present as the pancreas is in a paralized stage, also. The normal secretory stage of the pancreas is combined with a milking-like ("melk-artig," Westphal) action of the sphincter throwing out the pancreatic juice and the bile and preventing any reflux.

CONCLUSIONS

1. Operative manipulations upon the biliary duct system are the cause of atonia of the ducts and the papilla of Vater.

2. Atonia of the biliary system is the physiologic response to operative manipulations.

3. Reflux of the contrast medium during operative cholangiography does not prove a bile reflux under normal or pathologic conditions.

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SECONDARY OPERATIONS ON THE BILIARY TRACT*

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SECONDARY operations on the biliary tract are required in a distressing number of patients who have been subjected to surgical treatment for cholecystic disease. These operations are difficult, attended with considerable risk and entail much suffering, expense and time loss for the patient. Complications which require such operations are usually far more serious than the patient's original complaint. In some instances the complications peculiar to operations on the biliary tract may be attributed to the carelessness or ineptitude of the original surgeon, but in others technical performance has been above reproach. With adequate exposure anatomic relationships should not create undue confusion, but precise identification and dissection may be impossible when the tissues are involved in an acute inflammatory process. One cannot but wonder whether the persistent need for secondary operations and the actual increasing incidence of certain complications is not directly related to the growing popularity of early operation for acute cholecystitis.

Happily, 80 to 90 per cent of patients undergoing cholecystectomy may anticipate excellent results. Poor results may be due to incorrect diagnosis, residual disease, persistent choledocholithiasis, stricture of the common duct, so-called reformed gallbladder, functional changes, traumatic wound neuroma[19,28] or malignancy. We have reviewed the records of a number of patients of the Rockwood Clinic who required secondary operations on the biliary tract in the five-year period between 1946 and 1951. Patients having planned stage procedures such as cholecystectomy after preliminary cholecystostomy were not considered. Furthermore, we have had a tendency to shy away from surgery for functional disorders (biliary dyskinesia) despite the favorable reports of the effects of endocholedochal or transduodenal sphincterotomy by Lester and Colp,[18] preferring to leave management of such cases to our medical colleagues. Accordingly, we shall consider three principal problems: residual common duct stone, reformed gallbladder and common duct stricture. The cases having retained stones were our own; the remainder had the initial operations elsewhere.

Residual Common Duct Stone. The presence of a stone in the common bile duct after an operation on the biliary tract is a source of distress to both patient and surgeon. Pibram[23] estimates the incidence of this embarrassing circumstance to be 16 to 25 per cent. Ninety-five per cent of the secondary operations on the biliary tract performed by Hicken[12] and his associates were for overlooked stones. In the hope of obviating this complication some surgeons routinely explore the common duct when operating for cholelithiasis. Since the incidence of choledocholithiasis probably does not exceed 17 (Colcock[4]) to 24 (Best[2]) per cent, this seems unduly radical and most surgeons carry out exploration only in the presence of such indications as a history of jaundice, chills or fever, a palpable stone in the common duct, dilated common duct, dilated cystic duct with small stones in the gallbladder, or a thickened pancreas, which indications probably exist in about 45 per cent of patients having cholecystic disease.

Unfortunately, exploration of the common bile duct is a rather crude and largely blind procedure, so that even the most painstaking search by a capable and conscientious operator may fail to reveal all of the stones. In order to avoid leaving stones behind various technics have been devised. Meticulous probing of the common duct is routine, but the probe may pass by stones in the lower duct and will seldom discover the 7 per cent which, according to Best,[2] are intrahepatic. The duct is carefully palpated with and without the probe in place, mobilizing the second portion of the duodenum if necessary for adequate palpation of the retroduodenal portion of the duct. Yet in the

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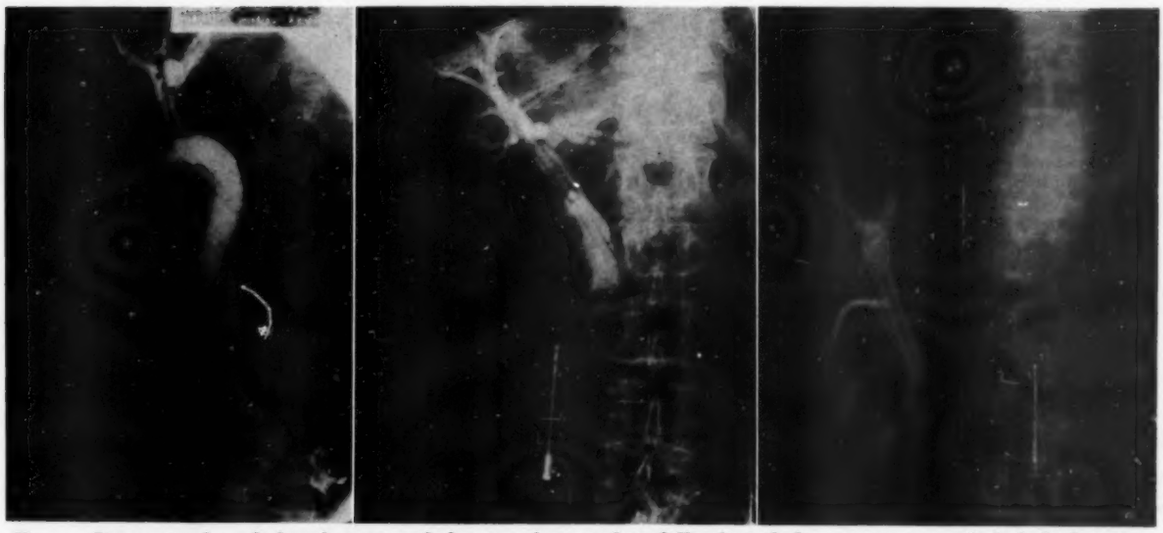

FIG. 1. Postoperative cholangiograms of three patients taken following cholecystectomy and choledochostomy demonstrating residual choledocholithiasis.

presence of marked inflammatory edema palpation is not informative. The duodenum may be opened and the ampulla of Vater inspected if the probe does not pass through the sphincter. Copious irrigations of the duct system with normal saline in the hope of washing out elusive rocks are usually carried out. Kirby[17] has described an ingenious electroacoustic device which makes audible the contact of a metal probe with a gallstone. A most helpful adjunct is the operative cholangiogram, first described by Mirrizzi and popularized by Hicken,[12] Hogan[10] and others.[24] This procedure need not add greatly to the operative time, if properly planned, and although not fool-proof, becomes increasingly reliable with practice and experience.[24] Yet in spite of every precaution stones may be left behind.

Three postoperative cholangiograms are shown in Figure 1. These were taken preparatory to removing the T-tube after it had been continuously clamped for twenty-four or more hours without causing distress. Had these films not been taken these patients might later have become "biliary dyskinetics." These films are those of a forty-seven year old woman, a sixty-six year old woman and a forty-two year old man. All three had subacutely or acutely inflamed gallbladders removed. The common duct had been explored in all, multiple stones being removed in two cases and sandy material in the third. Two of these patients had had jaundice. In none of the patients were any of the stones palpable at the time of operation. In two of the cases probes and catheters passed readily into the duodenum. Also in two, operative cholangiograms were taken and revealed no filling defect. After the presence of residual stones was established, two of the patients were subjected to biliary "flushes," not the gentle physiologic ones described by Best,[2] but the heroic ones of Pibram,[23] Strickler et al.,[25] using an ether-alcohol mixture after topical anesthetization of the duct and sphincter. In both cases flushes had to be discontinued because of pain and fever; after four days in one patient, after four weeks in the other. Secondary operations were carried out in all three cases six to twelve weeks after the initial operation. In the first patient the stone was removed by transduodenal choledochotomy; in the second, who had had only four days of flushes, only two stones remained to be removed supraduodenally; in the third, who had had a month of flushes, no stones remained at the time the common duct was explored. Both of the patients subjected to flushes exhibited marked pancreatic induration which we thought accounted for the pain they had been having. Operative and postoperative cholangiograms were normal and all three patients made uneventful recoveries and have remained well since.

Reformed Gallbladder. In removing the gallbladder if the cystic duct is tied too close to its junction with the common duct, there is a real danger of compromising the lumen of the

FIG. 2. Findings at operation on two patients showing so-called "reformed gallbladder."

latter. If too long a segment of cystic duct is left, it may dilate, harbor stones and remain a seat of chronic inflammation. Occasionally, in removing a swollen, edematous, inflamed gallbladder by the retrograde method identification of boundaries may be so difficult that the neck of the gallbladder remains. In some of these cases there may actually be enough functioning tissue left that the structure can be identified by routine cholecystography as in the cases described by Weingarten[28] and Bauer.[1] The symptoms to which these remnants give rise may be identical to those from which the patient suffered prior to the initial operation. There may be an interval of months or years before their onset. As Beye[3] pointed out in his report of fourteen cases in 1936, the term "reformed gallbladder" simply expresses a clinical situation and is not intended to conform with accurate pathologic nomenclature. The cystic duct remnant may have a thick, scarred wall and be contracted about stones or it may be thin-walled, dilated and full of bile. Microscopically the wall may resemble gallbladder or cystic duct, but always exhibits inflammatory changes. The recognition of this condition is not new. Walzel[27] wrote about it in 1921 and Kehr[16] in 1913 mentioned it as a cause of postoperative distress. As recently as 1934, however, Judd, despite his vast experience, wrote that he had never seen a cystic duct stump dilate and cause symptoms.[14] General appreciation of the syndrome followed the report by Gray and Sharpe,[9] in 1944, of forty-four cases subjected to secondary operation at the Mayo Clinic. Since then Hicken,[13] Garlock,[8] and others,[1] have described complete relief of symptoms in the majority of cases in which a pathologic duct remnant has been removed.

Figure 2 shows the findings at operation in two of our cases. Both cases were women, one aged thirty-six years and one, fifty years. Both patients had had stone-containing gallbladders removed elsewhere; in one instance ten years previously, in the other twenty-two years previously. In the former, symptoms were of two years' duration, in the latter of four years'. These symptoms consisted of upper abdominal pains, similar to the gallbladder attacks, nausea and dyspepsia. Cholecystography was attempted in one case; no dye was concentrated but the films showed the presence of calculi in the gallbladder area. (Fig. 3.) In neither case was there the slightest response to prolonged conservative therapy. In both cases operation revealed a dilated cystic duct remnant: 5 by 3 cm., thick-walled and containing stones in one; 2 by 4 cm., thin-walled and without stones in the other. Microscopic examination showed the wall to resemble chronically inflamed gallbladder in the upper portion and cystic duct in the lower portion. Both patients made uneventful recoveries following removal of the pathologic remnant and have been symptom-free since.

Common Duct Stricture. By far the most serious sequel to biliary tract surgery is stricture of the common duct. Here the patient is in imminent danger of losing his life. Multiple operations may be required to maintain patency, and the ingenuity of the surgeon is severely taxed. Worst of all, even if patency is restored, biliary cirrhosis may have progressed to such a degree that there is not enough functioning hepatic parenchyma left to maintain life or more than a life of chronic invalidism. The vast majority of strictures, of course, are the result of injuries incurred at the initial operation, the common duct being clamped, cut or sutured because of confusion regarding anatomic relationships, or during efforts to control hemorrhage. In these cases jaundice appears immediately postoperatively or after spontaneous closure of a biliary fistula. Delayed onset occurs in a few instances, presumably due to the sclerosing cholangitis which may be associated with a periductal abscess or collection of bile, occasionally on the basis of pancreatitis. Much has been written about methods of avoiding common duct injury with emphasis on adequate exposure, good relaxation, careful isolation of the juncture of the cystic duct with the common duct, careful identification of the cystic artery and all other structures before clamping, cutting or ligating them and of stopping hemorrhage with pressure on the hepatic pedicle rather than blind clamping.

The method employed for the correction of common duct stricture depends on how much duct remains or can be found proximal and distal to the stricture. Although Walters[26] believes that recurrent stricture is more apt to follow end-to-end anastomosis, most writers regard restoration of continuity by this method as the most desirable if it can be accomplished. Where the distal end is hard to find, Lahey[15] mobilizes the duodenum and dissects the intrapancreatic portion of the duct which seldom is injured; while Dragstedt and Woodward[7] advocate opening the duodenum and cannulating the duct through the ampulla of Vater. It is interesting that some of those who most ardently laud the protective action of the sphincter of Oddi and insist on its preservation, pass one end of the splinting T-tube down through it into the duodenum. Actually the importance of intestinal reflux into the biliary tree as a cause of cholangitis and liver damage is questioned by Walters, who regards recurrent stricture as the greatest obstacle to success, a fact borne out by the experiments of Musgrove and his associates.[21] Where the distal end cannot be found at all or is unsuitable for anastomosis, one may implant the proximal end of the duct into the duodenum, as described by Walters or into a loop of jejunum with an enteroanastomosis below, as described by Lahey, or into an antiperistaltic limb isolated by a Roux anastomosis, as described by Cole.[6] Where the only proximal ducts are intrahepatic, one may fashion a mucosal graft over a rubber tube from the isolated limb of jejunum and push this up into the liver substance to unite it with an intrahepatic duct. The ingenious efforts of Longmire[19] to circumvent the difficulties of intrahepatic anastomosis at the porta hepatis by amputating part of the left lobe of the liver and anastomosing a branch of the left hepatic duct to the jejunum are well known. Transplantation of an external fistula is seldom effective, but in a poor risk patient establishing an external fistula may be lifesaving and make subsequent definitive surgery safer. Hayes and Coller[11] have described such a method of decompression by employing the cystohepatic duct remnants.

FIG. 3. Plane roentgenogram of abdomen showing calculi in so-called "reformed gallbladder."

It is readily apparent that there is no universally applicable method for the correction of common duct stricture. The methods employed by us in operations upon five patients having such strictures are diagrammatically presented in Figure 4. In the first case a Vitallium tube was used to bridge the gap between an intrahepatic duct and the duodenum. This patient was temporarily improved but died eleven months later of recurrent obstruction and hepatic failure. In the second case end-to-end anastomosis was effected over a T-tube, the upper limb of which was split to engage each of the hepatic ducts. I am well aware that most writers inveigh against bringing the long limb of the T-tube out of the anastomotic site. This patient has been well for four years, since the removal of the T-tube. In the third case, three operations were performed at three-week intervals: first, drainage of an abscess, then establishment of an external fistula and, finally, cholangiojejunostomy over a plastic tube, one end of which was brought out through a stab wound in the isolated jejunal limb. This patient has had occasional mild bouts of cholangitis but has otherwise been well for two years. In the fourth case, hepatoduodenostomy was carried out over a T-tube, the upper limb of which was split as in the second case. After nine months the tube began to pass into the duodenum and was removed. This patient has been asymptomatic for over two years. In the fifth case a similar procedure was carried out, except that a plastic tube was employed, one end being inserted into the right hepatic duct and the other brought out through a stab wound in the stomach. This patient has been well for two and one-half years. Four of these patients were in their thirties and one was sixty-five years old. One of the patients had had a cholecystostomy, four had undergone cholecystectomy (one for non-calculus disease), three had had previous attempts at repair of their stricture; all exhibited varying degrees of jaundice and impaired liver function at the time of operation. The only postoperative complications were development of an abscess in the patient who subsequently died, and the breaking off of the plastic tube beneath the skin level in both of the cases in which this type of splint was employed. In both of these

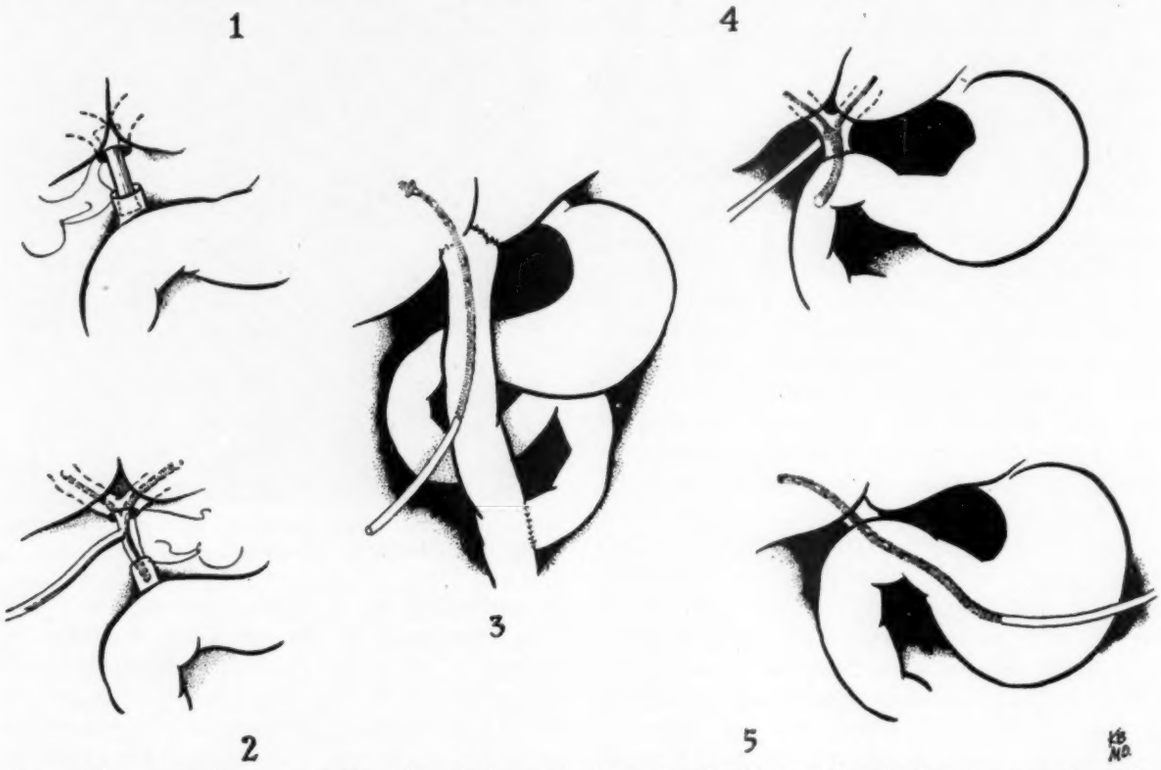

FIG. 4. Diagrammatic representation of surgical procedures employed on five patients having postoperative strictures of the common bile duct.

patients the skin healed over the broken tube promptly and there are no symptoms referable to the broken tube.

COMMENTS

Cholecystectomy in the eyes of many unfortunately has come to be regarded as a relatively innocuous procedure. A review such as this indicates that this is anything but true. Although the reports from some surgical centers indicate a mortality of less than 1 per cent (Colcock), Norgore[22] found that there were forty deaths in 1,000 consecutive cholecystectomies performed in Seattle. The poor results of cholecystectomy in the absence of real evidence of biliary tract disease are well known; but when one hears that 25 per cent of the deaths in the series reported by Norgore occurred in patients having normal gallbladders removed, one cannot but be appalled. Perhaps it would be better to follow the advice of Gordon who said, "An element of perspective might preserve a number of middle aged citizens to belch gas even to old age, rather than quell that belching prematurely and permanently."

SUMMARY

The principal complications of biliary surgery requiring secondary operation for their correction are residual choledocholithiasis, so-called "reformed gallbladder" and common duct stricture. The pathogenesis of these problems, preventive measures and methods for correction have been considered and illustrative cases presented.

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OPERATIVE TREATMENT FOR RECENT AND COMPLETE TEARS OF THE CORACOCLAVICULAR LIGAMENTS*

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THE initial treatment of a patient with a complete dislocation of the acromioclavicular joint taxes the ingenuity of the orthopedic surgeon. As frequently pointed out it is the continuity of the conoid and trapezoid ligaments that must be re-established in order to obtain a good functional result. The manual reduction of the dislocation is usually relatively easy. The problem of maintaining the reduction for six to eight weeks is frequently difficult for both the surgeon and patient. Non-operative methods involving the various types of bandages which have been described require constant attention. Even then it is difficult to maintain the reduction constantly until sound healing has taken place. Following this immobilization a prolonged period of physiotherapy is usually necessary to restore function.

Many forms of operative treatment have been described in the medical literature. These have included transarticular fixation with a Kirschner wire,[1] a coracoclavicular screw,[2,3] ligamentopexy,[3] and excision of the outer end of the clavicle.[4,5] In 1948 while one of us (C. F. O.) was at the United States Naval Hospital, Long Beach, California, it was suggested[6] that early internal fixation of these injuries by means of wire loop approximating the coracoid and the clavicle would lead to a good end result.

Recently we have treated three patients with complete acromioclavicular dislocations. Because of the gratifying results obtained in two previous cases which were treated by early open reduction and loop fixation, these three patients were treated in a similar manner.

OPERATIVE TECHNIC

The patients were given the routine orthopedic skin preparation; and under a general anesthesia, with a sandbag under the affected side, the following operative procedure was carried out:

The prominence of the coracoid process was palpated and an incision was then made beginning over the acromioclavicular joint and curving medially and distally past the medial margin of the coracoid process for a distance of 2 to 3 cm. This incision was then developed through the adipose tissue. The deep fascia overlying the deltoid muscle was incised in the plane of the incision. The periosteum over the exposed portion of the clavicle was incised and elevated in the usual manner, thus releasing, in part, the origin of the deltoid muscle. The fibers of the deltoid were then split for a distance of approximately 3 cm. and with the exploring finger the prominence of the coracoid process located. With the finger palpating the coracoid a semicircular wire guide director was inserted around the hook of the coracoid beneath the muscles which attach to the coracoid until the tip was visible, in the depths of the wound, lying just medial to the coracoid. A braided, stainless steel wire was then attached to the wire guide director which was withdrawn, leaving the wire firmly engaged about the hook of the coracoid. The medial end of the wire was then passed through a drill hole which was made through the clavicle in the superior-inferior plane. Manual reduction of the acromioclavicular dislocation was performed and the wire was then tied tightly. The wound was closed with interrupted layers of silk.

The wire we have found to be most satisfactory is a three-strand braided wire, each strand being a length of stainless steel wire .018 inches in diameter. Following surgery the patient was maintained in a sling and not encouraged to move the shoulder a great deal until approximately two weeks had elapsed. After that time, while still in a sling, the patient was placed on circumduction exercises with gravity eliminated at least three or four times a day. Usually, by the end of the seventh week, the sling was discarded and a relatively free range of motion was allowed the patient. At approxi-

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FIG. 1. Case II. Immediately post-trauma.

FIG. 2. Case II. Six weeks after operation; satisfactory reduction maintained.

mately eight weeks following reduction the wire was removed by reopening the superior portion of the previous incision.

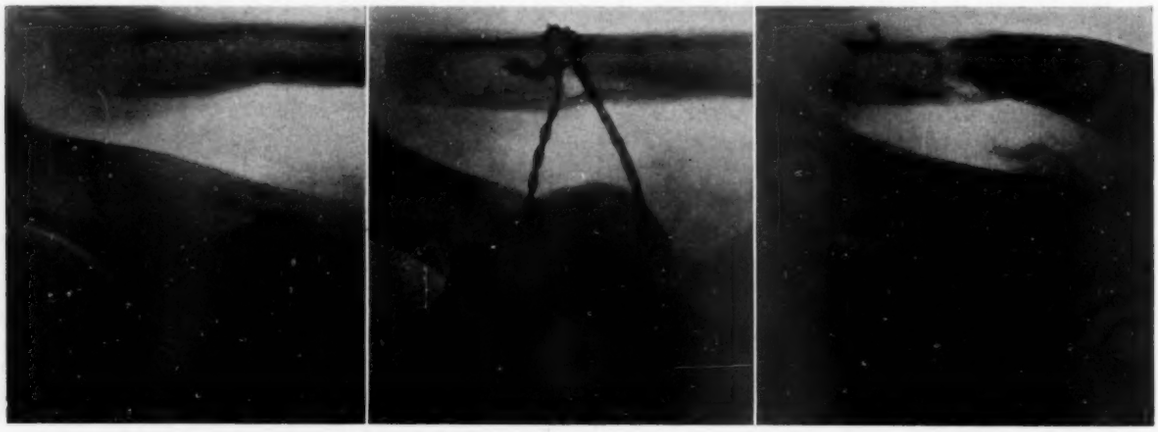
It should also be mentioned that in the cases presented it was found that both the trapezoid and conoid ligaments were completely disrupted. At the time of surgery it was also noted in Cases III, IV and V that there was complete disruption of the capsule of the acromioclavicular joint; however, when reduction was maintained with the wire, it was believed that no repair of the capsule was necessary. This joint was inspected in order to be certain that there was no interposition of soft tissues.

CASE REPORTS

CASE I. R. C., a chief radioman, was admitted to the hospital in November, 1948, within twenty-four hours of an accident in which he suffered a left acromioclavicular dislocation. At x-ray conference the following morning it was suggested that a method of internal fixation involving wiring of the coracoid process to the clavicle be utilized to maintain reduction. Accordingly the previously described procedure was carried out. The incision was shorter than that described and the acromioclavicular joint was not visualized, but the coracoclavicular ligaments were completely disrupted. The postoperative course was uneventful. The wire was removed at the end of the sixth week and the patient was returned to full duty nine weeks postoperatively. At that time he had a full, painless range of motion of the left shoulder girdle.

CASE II. A. A., a Seabee, was admitted to the Civil Administration Unit Dispensary, Truk, E. Caroline Islands, in June, 1950, a half hour after he had fallen upon the point of his left shoulder from the back of a weapons carrier. A diagnosis of left acromioclavicular dislocation was made clinically. X-rays showed that the patient had a fracture of the clavicle within 1 inch of the distal end. (Fig. 1.) The acromioclavicular joint appeared to be intact but the proximal end of the fracture was displaced cephalad and posteriorly. Because of the successful termination of Case I and the difficulty of maintaining any sort of restrictive dressing in the tropics, the wiring procedure was carried out. As was suspected from the x-ray picture there was a complete disruption of the conoid and trapezoid ligaments while the acromioclavicular joint was intact. A satisfactory reduction of the fracture was obtained with wire fixation. At the end of eight weeks when satisfactory union of the clavicle was demonstrable roentgenologically (Fig. 2), the wire was removed. Within three weeks after removal of the wire the patient was performing the normal duties of his rate which involved the mechanical repair and driving of trucks and tractors. He was seen at varying intervals until December, 1950, at which time he was transferred. He had no limitation of motion of the left shoulder girdle nor any pain referable to that area.

CASE III. F. A., a twenty-five year old white man, was admitted to the Naval Hospital, Memphis, Tennessee, on August 22, 1951, following an automobile accident. At the time of admission the patient's only complaint was that of pain in his right shoulder. Examination revealed an increased prominence of the lateral end of the right clavicle. There was considerable swelling, pain and discoloration over the right acromioclavicular joint and the lateral end of the clavicle had a markedly increased mobility. On August 28, 1951, the afore-described op-



3 4 5

FIGS. 3 to 5. These represent the x-ray findings in Case v. It will be noted that in Figure 3 the clavicular-coracoid distance measures about one-third greater than in Figure 4 (immediately postoperative). Figure 5 was taken one week following removal of the wire.

erative procedure was carried out under general anesthesia. Although the postoperative course was very satisfactory, x-ray examination several days following the procedure revealed that the position of the clavicle in relation to the acromion was definitely improved, but a completely satisfactory reduction had not been maintained. Accordingly, on September 6, 1951, the previous incision was opened and the wire mobilized and found to be somewhat loose. A satisfactory reduction of the clavicle was obtained manually and the wire tightened. Following this second procedure the patient had an uneventful convalescence. However, on an x-ray examination seven weeks following the injury it was noted that there was considerable calcification taking place in the coracoclavicular ligaments. This did not interfere with the motion of the shoulder girdle.

Eight weeks following the second operative procedure the wire was removed and the patient was started on fairly intensive physiotherapy. Approximately two weeks after the removal of the wire he had a practically normal range of motion of the right shoulder girdle and was discharged to full duty.

CASE IV. E. W., a nineteen year old white male, admitted to the Naval Hospital, Memphis, Tennessee, on October 12, 1951, after he had been involved in an automobile accident approximately twenty-four hours prior to admission. The patient had been in another hospital prior to this admission. When first seen at the Naval Hospital, a marked posterior displacement of the lateral end of the right clavicle was evident upon clinical examination. There was an associated swelling, pain and discoloration of the right acromioclavicular joint. X-ray examination at the time of admission revealed lateral superior displacement of the clavicle; however, an axial view of the acromioclavicular joint revealed a complete posterior displacement of the lateral end of the clavicle.

On October 15, 1951, the afore-described operative procedure was carried out on this patient under general anesthesia. His postoperative course was completely benign. At operation the frayed ends of the acromioclavicular joint capsule were well approximated after the wire suture had been tied and did not necessitate further repair. By November 7, 1951, with the wire still in place, the patient had completely normal motion of the right shoulder girdle.

Approximately eight weeks following the initial operation the wire was removed and the patient allowed complete freedom of motion of the right shoulder girdle. Approximately ten days following the removal of the wire he was completely symptom-free, had a normal range of motion of the right shoulder and was discharged to full duty.

CASE V. F. P., a nineteen year old white male, was admitted to the Naval Hospital, Memphis, Tennessee, on October 21, 1951, because of an injury to the left shoulder incurred while engaged in a football game. On admission, examination revealed an elevation and posterior displacement of the lateral end of the left clavicle. This was associated with increased mobility of the clavicle, pain, discoloration and swelling over the left acromioclavicular joint.

X-ray examination confirmed the diagnosis of complete acromioclavicular dislocation. On October 25, 1951, the afore-described operative procedure was carried out under general anesthesia. At operation, again, the coracoclavicular ligaments were found to be completely disrupted and, following suture, satisfactory approximation of the acromioclavicular joint capsule was evident without actual suturing of the capsule. Postoperatively the patient had a completely benign course and by the end of the fifth postoperative week, a normal range of shoulder girdle motion was present. The wire was removed seven and a half weeks after the initial operative procedure. Within ten days the patient had normal range of motion and was discharged to full duty. (Figs. 3 to 5.)

X-ray examination of these three cases was made one to two weeks after the removal of the wire and it was found that there was no change in the relative position of the clavicle to the acromion following removal of the wire. Cases III, IV and V were asymptomatic and performing the full duties of their rate on July 15, 1952.

COMMENTS

Although it is true that the method of treatment of the cases we have presented has involved an operative procedure under general anesthesia, the final functional result in these cases has been very gratifying. In general the postoperative disability and discomfort in these cases has been minimum. All of these patients were up and about the ward within twenty-four hours following surgery and within three days were involved in the usual ward activities seen in the Naval Hospital. We believe that this is a simple operative procedure and is more satisfactory, both to the physician and to the patient, than the maintaining of the restrictive bandages which have been described in order to treat this condition in a non-operative fashion. We also believe that the method of maintaining the reduction by means of a flexible wire is probably superior to the rigid reduction obtained by use of a screw passing from clavicle to coracoid process.

In three of the cases presented herein we have observed that calcification of the coracoclavicular ligaments was evident in the x-ray examination within four to five weeks following the reduction. As has been previously pointed out by Soule[7] the calcification or ossification of the coracoclavicular ligaments following trauma in this location is a relatively common finding and does not seem in any way to interfere with the function of the acromioclavicular joint at a later date. On the other hand it would appear that this process of calcification is merely an indication on the x-ray examination that the healing process is progressing. Certainly it was true in the cases we have seen that calcification did not appear to limit function in these patients.

SUMMARY

1. An operative method for the treatment of recent and complete tears of the coracoclavicular ligaments has been presented in detail.

2. Five patients with complete acromioclavicular dislocations have been treated by the operative method described and have had completely benign postoperative course, returning to full duty within ten weeks. These patients had a completely normal range of shoulder girdle motion and were also symptom-free.

3. Early operative treatment for complete tears of the coracoclavicular ligaments should be instituted as soon as the patient's general condition will allow surgery under a general anesthesia.

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PROTRUSIO ACETABULI*

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DISABILITY arising from abnormal articulation of the femoral head and the acetabulum commonly results from a shallow acetabulum or an enlarged head not securely fixed within the acetabular cavity. Congenital dislocations, subluxations and dysplasias of the hip joint have been intensively studied. The opposite condition of an excessively deepened acetabulum with the femoral head deeply imbedded is not quite as well known.

Protrusio acetabuli, Otto's pelvis or arthrokatadysis are some of the terms employed to designate this condition in which the medial wall of the acetabulum protrudes into the lesser pelvis and permits the femoral head and often portions of the neck to be encompassed completely by the deepened acetabulum. This deformity was first described in a museum specimen by Otto, in 1824, who regarded it as a form of arthritis. Since then case reports and some discussion of the etiology have appeared in the literature but precise knowledge of its incidence, etiology, age of onset, progression and treatment has not been realized.

The study of this subject was for a long period in a confused state due to the inclusion of all cases of protruding acetabula regardless of cause. Tuberculosis, carcinoma and trauma were grouped together with other cases of less apparent etiology.

Gilmour[2] divided intrapelvic protrusions into two categories. There is a primary group of obscure origin in which the deformity exists for a varying period of time in an uncomplicated state, with a degenerative arthritis developing later. A large percentage of these cases occur in women and many of the cases are bilateral. In the second group of cases the protrusion can be traced to a specific antecedent disease or injury to the acetabular floor or femoral head. The preponderance of such cases are not women and bilaterality is uncommon. Arthritis, osteochondritis, gonorrhea, echinococcus infections, Paget's disease, tuberculosis, osteomalacia and trauma have been reported as causative agents. This report will be concerned only with the primary group in which the process has appeared without any demonstrable focal cause, the clinical symptoms developing insidiously and often over a period of years as secondary osteoarthritis supervened.

Gilmour analyzed thirty-seven reported cases, all of the primary type. He noted the deformity to be predominant in women (thirty women and seven men), while seventeen of the cases were bilateral. Interestingly, in many of the unilateral cases the normal acetabulum was abnormally deep but not actually protruding within the pelvis. Most previous reports concerned patients in whom the condition was noted after the age of twenty. In some, the diagnosis was made in the sixth decade, but the histories of many of these definitely go back to the period of maturity when stiffness of the hips and other disabilities were recalled. In the cases reviewed by Gilmour the history went back to adolescence in ten patients, all of whom were women.

In 1936 Rechtman[6] was able to gather from the literature, together with his own cases, eighty-four cases of intrapelvic protrusion reported in the 110 years since Otto first described the disease. Some of these cases were due to acute and chronic infections localized to the pelvis and thus of the secondary type. The youngest patient found in the literature was a girl of twelve years reported by Overgaard.[4]

The onset of symptoms varies considerably. Early in the disease symptoms were referable to a gradual limitation of hip motion, stiffness being recalled as the first complaint. Later, as the joint surfaces alter and osteoarthritis develops, pain and limp are noted. Joints other than the hip are not involved and systemic symptoms are usually not recalled. Examination reveals abduction and external rotation

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to be most severely limited but all motions of the involved hip fall short of a normal range. The patient often demonstrates a lordosis, which may not be associated with hip flexion deformity, as well as pelvic rotation and shortening. When the protrusion is advanced, a globular mass can often be felt on the inner wall of the pelvis on abdominal palpation.

The early roentgen picture shows the medial acetabular wall to protrude a varying amount into the lesser pelvis and the femoral head to be held closely to the medial wall. The presence of a frank protrusion offers no problem but roentgenographic criteria for the borderline cases of protrusion or an abnormally deep hip joint without actual protrusion present some difficulties. Overgaard suggests that the diagnosis of protrusion be made only when the inner floor of the acetabulum touches or is displaced medially to the linea terminalis of the pelvis on a well centered frontal projection of the pelvis. He also emphasizes alterations in the pear or tear drop figure which is formed by the intersection of three lines. In the normal hip the most lateral line corresponds to the acetabular floor, the medial line to the inner pelvic wall while the bottom line is the anterior obturator tubercle. This figure shows a variety of patterns but when the medial and lateral lines reverse their positions so that the acetabular line is medial to the pelvic wall line an abnormally deep hip socket is said to be present. The inversion of the tear drop figure is thought to indicate an abnormally deep acetabulum but not necessarily a protrusion of the femoral head. The semilunar surfaces of the acetabulum which bear the transmission of pressure may retain the head in a normal relationship even though the acetabulum is excessively deep. The acetabular fossa of such an acetabulum shows increased depth and is filled with fat and areolar tissue. Thus two factors must be present for the primary form of this disease to develop, namely, a deepened acetabulum and a femoral head displaced toward the medial border. The latter suggests an alteration or destruction of the lunate weight-bearing surfaces of the acetabulum. A very marked inversion of the tear drop figure usually also presents an inward displacement of the femoral head. Thus the term protrusio acetabuli is poor as it does not describe the complete picture.

Another method of determining the presence of an abnormally deeply seated head with a protrusion is the employment of the CE angle of Wiberg. This angle which expresses the femoral head relationship to its articulation with the acetabulum has been widely used in the past to diagnose subluxations or hip dysplasia with shallow acetabula but can also be used to indicate a too deeply seated head.

TABLE 1
SUMMARY OF CASES REPORTED

Case No.	Age	Age at Onset of Symptoms	CE Angle		Side Involved
			Right	Left	
1	8	7	40	40	Bilateral
2	14	12	70	55	Bilateral
3	22	11	55	57	Bilateral
4	39	31	43	47	Bilateral
5	16	16	20	65	Left
6	48	48	55	45	Bilateral
7	59	55	45	55	Bilateral

This CE figure which measures the angle between a perpendicular drawn through the geometric center of the femoral head and the outer edge of the acetabulum was noted by Wiberg to range from 20 to 46 degrees in normal adults, with an average of 36 degrees. Severin extended the use of the CE angle to children. Children from six through thirteen years showed a range of from 15 to 40 degrees, with an average of 30 degrees. Children over fourteen years of age showed adult values. Table 1 indicates the CE angle for the cases reported in this series.

A rotengenographic study of the CE angle of seventy patients without complaints referable to the hips was undertaken. The average CE angle was 33 degrees. In three instances the CE angle measured greater than 45 degrees. Only one patient showed a CE angle over fifty, both hips of this patient showed a fully developed acetabular protrusion. This patient was a woman, aged forty-one, without secondary joint changes.

Secondary arthritic changes are commonly encountered with protrusio acetabuli in later life. The acetabular floor becomes thickened and sclerotic while the joint space diminishes

FIG. 1. Case 1. Showing early protrusion.

FIG. 2. Case 1. Showing advancement of the process six months later.

and osteophytes develop along the outer edge of the acetabulum and the femoral head. The outline of the acetabulum develops more fully on the medial and inferior surfaces, becoming semi-circular. This finding is not usually seen in arthritis without inward protrusion and is due to a more widespread contact between the head and its socket.

Seven patients with deepened acetabula and inward protrusion of the femoral heads of the primary type have been intensively studied. All of the patients were women and six of the seven reported cases showed bilateral involvement. Six of the patients were Negroes. This incidence has not been previously reported and we are unaware of its significance. The age of our patients varied from eight to fifty-nine years. The ages of onset of clinical symptoms varied from seven to fifty-five years and occurred at or before adolescence in four of seven cases. The exact age of onset in the three patients reporting symptoms after adolescence is difficult to ascertain but the deformity was present for at least eight years in one case.

CASE REPORTS

CASE I. C. J., an eight year old Negro girl, was admitted for study of a limp associated with pain referred to the left hip joint. It was noted by her parents that she presented an increasing lumbar lordosis during the past year. Up to the onset of her present complaints the child had suffered no significant illnesses. The family history was negative for diseases related to the musculoskeletal system. Examination revealed a thin, tall girl, with a markedly increased lumbar lordotic curve, who walked with a limp, favoring the left lower extremity. The spine was normally mobile as was the right hip joint. The left hip showed limitation of flexion and abduction. Blood count and differential as well as urinalysis were within normal limits. Sedimentation rates were elevated on several occasions, averaging 26 mm. per hour (Wintrobe method). Tuberculin tests were negative in all dilutions. The serologic tests for syphilis and a vaginal smear for gonococcus were negative. Roentgenograms of the hips revealed a bilateral deepening of the acetabula with deeply imbedded femoral heads and a well developed inner acetabular wall. (Fig. 1.) No secondary changes were noted in the hip joints. The CE angle on the left and right sides was 40 degrees. Six months after the original films this angle showed an increase to 55 degrees on the right and 50 degrees on the left. (Fig. 2.) An increased lumbar lordotic curve with a mild scoliosis of the lumbar spine to the left was noted. Films of the chest and skull were negative.

Comment: From a study of the available literature this is the youngest patient with a primary protrusion of the acetabulum yet to be reported.

CASE II. J. F., a fourteen year old Negro girl, had been complaining of pain and stiffness of both hips progressing slowly for two years. During this period she was treated with traction and bedrest in another institution. No past illnesses were recorded. Her menses began at the age of thirteen. There was no family history of diseases related to the locomotor system. The right hip was fixed in neutral rotation in 150 degrees' extension; the left hip flexed to 130 degrees and extended to 145

FIG. 3. Case II.

of the right hip which was stretched and then treated for a three-year period in traction and casts. She was finally discharged, walking with crutches. Following this treatment a gradually increasing stiffness of both hips occurred.

Examination revealed both hips to be fused in full extension in a neutral position. No other joints were involved. Roentgenograms revealed bilateral protrusio acetabuli with a CE angle of 55 degrees on the right and 57 degrees on the left, with marked secondary arthritic changes in the hip joints. Both limbs were of equal length and knee function was normal.

FIG. 4. Case IV. Eight years prior to the development of acute symptoms.

FIG. 5. Case IV. After development of secondary joint changes. There is no further progress of the protrusion.

degrees and showed a markedly reduced range in all other planes of motion. The limb lengths were equal and there was slight atrophy of the right calf and thigh. The remainder of her joints were normally mobile and painless. Roentgenograms revealed bilateral pelvic protrusion with narrowing of the hip joints and slight flattening of the inner acetabular wall and the medial surface of the head. (Fig. 3.) The CE angle was 70 degrees on the right and 55 degrees on the left. No abnormalities were encountered in the blood picture, urinalysis, serum calcium, phosphorus or alkaline phosphatase. The Kolmer and Kline tests were negative and the highest sedimentation rate 17 mm./hour. Treatment consisted of preliminary traction followed by nylon hip arthroplasties from which the patient is now convalescing.

CASE III. L. H., a twenty-one year old Negro woman, complained of stiff hips of several years' duration. At the age of eleven she was hospitalized elsewhere for a disturbance

Blood counts and urinalyses, protein determinations and serum calcium, phosphorus, and alkaline phosphatase were within normal limits. The Kolmer and Kline tests were negative and the corrected sedimentation rate, 15 mm./hour. In June, 1951, a Vitallium cup arthroplasty was done on the right hip and afforded an opportunity to inspect the joint. The joint line was thinned and scarcely detectable, with little remaining cartilage. The acetabulum was deep but otherwise no abnormalities were noted. Microscopic sections of joint tissue and the subjacent bone were not remarkable; cultures of the hip joint were negative.

CASE IV. M. E., a thirty-nine year old white woman, complained of back pain and right knee pain. At the age of thirty-one a film of the pelvis, taken elsewhere, showed inward protrusion of the femoral heads without secondary joint change. (Fig. 4.) There were mild symptoms of stiffness at that time referable to her back and hips. Several years later

FIG. 6. Case v.

she began to complain of back pain which responded somewhat to conservative measures but later recurred in association with right knee pain.

On examination she walked awkwardly. The right hip was fixed in a flexed position of 120 degrees while the left showed a range of motion from 90 to 180 degrees with marked restriction of rotation.

Roentgenograms showed bilateral intrapelvic protrusion of the femoral heads with arthritic changes. (Fig. 5.) The degree of protrusion was no greater than that shown on the films taken eight years previously but severe degenerative changes were now superimposed. The CE angle on the right was 43 degrees, on the left 47 degrees. Both hips showed new bone proliferation extending the superior acetabular lip laterally so that it approached the superior surface of the neck. The inner wall of both acetabula was displaced medial to the inner pelvic wall. Treatment consisted of traction, manipulative therapy and an acetabuloplasty on the right which allowed an increase in joint function. Her subsequent course over the next four years changed little.

Comment: Films of this patient taken eight years prior to her acute symptoms showed the protrusion. There was no further deepening of the acetabula over a span of eight years although marked degenerative changes developed and the heads lost their hemispherical shape.

CASE V. N. M., a sixteen year old Negro girl, stated that she had increasing difficulty in walking due to stiffness of the left hip for the past four months. The stiffness was first noted following an attack of joint pain involving the left shoulder and knee; this episode was accompained with fever but without joint swelling or redness. She was treated by her local doctor with bedrest and salicylates. A diagnosis of rheumatic fever was made. The attack was the first of its kind lasting two weeks and on becoming ambulatory again the hip disability was first noted. The patient was delivered of a normal full term child at the age of fourteen. There is no family history of disease of the musculoskeletal system. Physical examination was negative except for the left hip which demonstrated no motion, being fixed in flexion of 160 degrees and in 10 degrees of abduction and 20 degrees of external rotation.

Roentgenograms showed an intrapelvic protrusion of the left femoral head with a CE angle of 65 degrees on the left and 20 degrees on the right. (Fig. 6.) There was evidence of narrowing of the left hip joint and some early flattening of the head. Films of the cardiac silhouette indicated a mild degree of mitral stenosis. An electrocardiograph showed a normal tracing. The sedimentation rate was markedly increasing (42 mm.), blood serology negative, vaginal smear negative for gonococcus, serum calcium, phosphorus and alkaline phosphatase within normal limits.

Treatment consisted of traction and bedrest over a period of several months, with little change in the roentgenogram or clinical findings, following which the patient refused further treatment.

Comment: This patient suffered an overt attack of acute rheumatic fever four months prior to the first x-ray films. Whether acetabular protrusion was related to this or antedated it is a point of interest which cannot be answered.

CASE VI. A. A., a forty-eight year old Negro woman, complained of moderately severe backache of four months' duration following a hysterectomy for uterine fibroids. She also stated that her right knee has been occasionally painful for the past eight weeks. There was no history of any pain, stiffness or disability relative to her joints prior to the present complaint. There was no pertinent family history. Examination of the spine revealed spasm and tenderness in the lumbosacral area associated with an increased lordosis. There was a normal range of spinal mobility but mild restriction of abduction was noted in both hips. She lurched slightly when walking. The Trendelenburg test was positive on the right. Roentgenograms showed

a bilateral protrusio acetabuli with slight hypertrophic changes in the hip joints and in the lumbosacral apophyseal facets. (Fig. 7.) The CE angle measured 55 degrees on the right and 45 degrees on the left. The patient was fitted with a back support which controlled her back pain. However, she is still bothered with pain radiating to the knee on the right which restricts her walking to less than a quarter of a mile.

Comment: This patient gave no history of hip disability prior to eight weeks before examination. There were few physical findings and the films of her hips showed only mild degenerative changes although the protrusions were moderately severe.

CASE VII. C. B., a fifty-nine year old Negro woman, was first seen because of pain and stiffness of the left hip of four years' duration. There was no history of injury or previous disease related to the skeletal system. The patient denied any pertinent family history. The pain had gradually increased until it now almost completely incapacitated her. Examination revealed the patient to stand with the left hip flexed and the trunk inclined forward. Motion in the left hip was mildly painful with flexion to 90 degrees and extension to 140 degrees. The left hip was fixed in 10 degrees of adduction and neutral rotation. The right hip showed moderate restriction of rotation and abduction. There was also some restriction of spinal motion. Roentgenograms revealed a bilateral intrapelvic protrusion with marked arthritic changes in the left hip and mild changes on the right and changes of a moderate degree in the lumbar spine. The CE angle was 45 degrees on the right and 55 degrees on the left.

OBSERVATIONS

Gilmour believes that the primary form of this condition is a result of an acceleration of primary epiphyseal ossification in the pelvis replacing the resistant cartilage with new vascular and plastic bone which undergoes molding from weight bearing. Rechtman regarded it as a congenitally deep acetabulum resulting from overgrowth of the innominate bone. Three of his five cases gave a pertinent familial history. Schaap[7] concurs in this viewpoint.

No definite light can be cast on the etiology of this condition from the material presented.

FIG. 7. Case VI.

It is strongly suspected that all such cases of primary protrusion of the hip joint occur at a young age and that the protrusion, once developed, does not often continue to increase. Schaap reported a woman of forty-five years followed for five years with no further protrusion. Case IV in this series showed no further progression of the protrusion over an eight-year period. Golding[3] made a five-year follow up on a woman, aged forty, and did not note any further progression of the protrusion. On the other hand, Case I in this series, a girl of eight years, has shown progression of her protrusion. Ghormley and Flashman[1] followed a twelve year girl for one year, noting progression of the deformity. The preponderance of young girls with bilateral involvement without an infectious or traumatic incident and without joint involvement elsewhere who complain of gradually increasing disability as the deformity progresses would suggest that we are dealing with a developmental or congenital change localized to the hip joints. Such changes may be akin to those which occur in a slipped femoral epiphysis, the primary changes occurring in a period of rapid growth and involving the cartilages and bones of the structures forming the hip joint. In our present state of knowledge the treatment of this condition, if diagnosed early in a young individual faced with the prospect of further deformity in the immediate future would most logically be restriction of weight bearing and traction.

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The most common sign in cancer of the breast is a lump. Axillary glands may be involved and the lesion may still be operable. Automatically, we know there are no communications between these axillary glands and those normally situated above the clavicle. Therefore, if the supraclavicular glands are obviously involved by metastases, it means that cancer of the breast has already spread into the thorax and has then reached the supraclavicular glands via the upper intercostal spaces. Such a case is obviously inoperable and chest films will usually prove this actually to be the case. In the so-called operable cases some surgeons prefer preoperative irradiation and radical mastectomy, reserving postoperative radiotherapy for recurrent cases only. The practice seems a good one provided one can be sure of the diagnosis before surgery. If a frozen section is taken for biopsy purposes and it turns out to be malignant, I think the surgeon should immediately proceed with a radical mastectomy and then the radiotherapy will necessarily have to be a postoperative procedure. In more advanced cases and especially in younger women, I also believe x-ray castration should be done. I believe it helps to prevent recurrences. (*Richard A. Leonardo, M.D.*)

EPIDERMOID CYST OF THE TERMINAL PHALANX OF A FINGER

WITH A REVIEW OF THE LITERATURE

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EPIDERMOID cyst of the distal phalanx is a rather infrequent entity and not many cases have been reported. The incidence of the lesion is greater in the soft parts without bony involvement. The earliest report in the literature of this condition was that described by Wernher in 1855.[1] Other reports of this pathologic entity were made by such men as Rizet,[2] Muron,[3] Gillette,[4] Masse,[5] Troquart[6] and Gibier.[7]

Reverdin[8] gave one of the most graphic descriptions of this tumor as to pathology, diagnosis and treatment, and reviewed the literature up to the date of his article. Since then other reports have appeared describing epidermoid cyst.[9–15] More recent cases were presented by Sonntag,[16] Friedländer,[17] Hammann,[18] Harris,[19] Behrens,[20] Curtis and Owen,[21] Wien and Caro,[22] Bissell and Brunschwig,[23] and Yachnin and Summerill.[24]

Nomenclature. Various terms have been used to describe this pathologic entity. In the French literature Rizet[2] referred to them as dermoid cysts, and Troquart[6] and Reverdin[8] as epidermic cysts. Such terms as epidermoid (Franke[11]), traumatic epithelial cysts (Garre[9]), atheroma (Schweninger[25]) and traumatic epidermoid (Blond[26]) have appeared in the German literature to describe this entity. The English terminology has been that of implantation cyst (Sutton[10]), implantation dermoid (Burrows[27]) and epithelial cysts of traumatic origin (McCarthy[28]).

Age and Sex. A review of the cases reported reveals that these cysts have not been observed in children and are rarely found in the adolescent.

Garre[9] studied thirty-five reported cases, and in this series only three were women. Although the authors' review does not reveal such a marked predominant ratio, the incidence of men having this entity has been found to be greater than that of women. This is readily understandable in view of the more hazardous occupations of men.

Role of Trauma. It is interesting to note that with the greater number of men affected one can look for trauma as a possible relative cause. Wörz[12] in a review of fifty-five cases found that twenty-four patients had a history of trauma. Behrens[20] first made the interesting observation that the trauma was more apt to be blunt than sharp, with which Wien, Caro[22] and the authors concur. In a review of the literature the authors found that working people were the predominant group affected with epidermoid cyst. These cysts tend to, occur in the fingers and the palms of the hand, that is, the exposed areas of the body. Sonntag[16] reported a case involving the middle phalanx of the ring finger, although the terminal phalanx is most often affected.

The appearance of the tumor in the reported cases varies from several months[9] to thirty-four years[27] following trauma. Sonntag[16] reported a case in which trauma had taken place twenty-four years before. However, the usual elapsed time of previous trauma and the appearance of the cyst is that of one year or more.

Theories. Franke[11] believed that these tumors for the most part could be traced back to an embryonal anlage in the form of cones of epithelium originally destined for the creation of glands that became coiled. These coiled embryonal collections of cells remained intact and continued to develop in extrauterine life either of their own accord or in response to a stimulus such as a blow or pressure. Franke believed that trauma played a small part in these tumors. Reverdin[8] was of the opinion that trauma played the predominant role in the development of this tumor. He believed that trauma to the epidermis caused it to be torn and epidermis to be deposited deeply in the subcutaneous tissue where the cyst formed. Reverdin cites the work of Gross[29] who was the

first to expound the theory of trauma. Garre,[9] Hammann[18] and Behrens[20] also were of the opinion that epidermoid cyst is the result of trauma.

Experimental Work. Masse, at the French Congress of Surgery in 1885, announced that he had been successful in producing artificial dermoid cysts. He introduced the fragments of tissues or limbs of rats into the abdominal cavity of other rats, thus producing artificial dermoid cysts. By introducing under the skin of white rats the strips of skin from young rats, he was able to produce pearly, transparent tumors.[5] This experiment seemed to substantiate the trauma theory of Gross and Reverdin.

Kaufmann first experimented with newborn dogs or those only a few days old, but these animals soon died. His experiments with older dogs and rabbits were no more successful in that the wounds suppurated. Kaufmann then turned to combs and wattles of hens and roosters which were entirely free from hairs and presented a smooth field of operation. He was able to produce a cyst from the transplanted epidermis.[30]

Schweninger, in dogs and rabbits, made a circular incision around a piece of skin or a breast nipple and the incision wounds were drawn together over the excised skin, leaving the detached piece in subcutaneous position. He was thus able to produce cysts that at times contained hairs and sebaceous glands in the wall, while fat and cholesterol were found in the lumen.[25]

Pels-Leusden, in an address before the Free Society of Surgeons of Berlin on June 19, 1905, cited his experiments using rabbits' ears. He made sharp incisions in the skin of rabbits' ears and placed platelets of magnesium in the superficial layers of the cutis. In the early stages examination revealed partial epidermization around the foreign body, while in the later stages there was complete development of a normal epidermis with all of the strata. Pels-Leusden believed that isolated epidermis or fragments die without exception, while epidermis with a tiny bit of cutis heals in position and gives rise to the formation of an epithelial cyst. Pels-Leusden in his work stated that a prerequisite for the success of his experiment seemed to be that the cavities should be formed in the region of the appendages of the skin and that they be preserved for a time by means of a foreign body.[13]

Hesse in his experiments agreed with Pels-Leusden. In his experiments, using forty-seven rabbits, Hesse showed clearly that epithelization occurred only at sites of injury to the appendage; uninjured appendages did not epithelize. The wider the injury, the more extensive and more fully developed was the epidermization.[15]

Appearance. Grossly, the epidermoid cyst is a small rounded or oval tumor. It varies in size from that of a pea to that of an almond. It consists of a hardish covering filled with a whitish content similar to that of sebaceous cysts. A review of the literature discloses that the content of the cysts has been described variously as whitish, pasty, similar to grease, sometimes yellowish, clotted, meliceric. In exceptional cases the content was found covered with calcium or even completely calcified. The content of one of the cysts operated upon by Rizet was compared to the pit of a peach. This suggests an osteoid osteoma.

Microscopically, the tumor is composed of a cystic cavity with a whitish keratinized membrane and horny debris. The absence of hair or other skin appendages differentiates it from dermoids, while the character of the wall clearly separates it from simple sebaceous cysts.[31]

Treatment. Recurrences have followed removal of the bone cyst by curettage. When a phalanx is involved, the phalanx should be excised in most cases.

CASE REPORT

N. L., a fifty year old male, was first seen May 25, 1950, after the little finger of his right hand had been struck by a leverage rope. The patient experienced great pain and tenderness in the finger, especially upon pressure.

Three or four days prior to the injury he had hit the end of the same finger when he was picking up something from the floor. The finger hurt a little at this time. Prior to this incident the patient had never experienced any difficulty with the finger.

On examination the terminal portion of the little finger was found to be enlarged, especially in the transverse diameter. The nail of the little finger on the right was half again as large as that on the left. From the distal interphalangeal joint outward, the finger was one-third larger than the left. It was not discolored. The nail was deformed, being bowed, with the apex presenting on the dorsum. The base of the

FIG. 1. X-ray films showing destructive lesion of the distal phalanx of the little finger with a pathologic fracture.

nail on the radial side was very sensitive but no definite mass could be felt. Pulsation in the terminal phalanx could be obtained for a few days following the injury but could not be demonstrated at a later date although the patient complained of a "hammering" sensation.

Radiograph (Fig. 1) showed a loss of substance in an oval area involving the middle portion of the terminal phalanx throughout almost its entire diameter. It appeared in the form of a letter "C" with an open defect on the radial side ¾ inch long. On the ulnar side the thin wall of the cavity had been fractured, there being no bony wall on the radial side. Except for the pathologic fracture, the lining of what seemed to be a cystic area was quite smooth and there was no evidence of invasiveness. At both the proximal and the distal portions of the terminal phalanx there was intact bone somewhat less than ¼ inch in thickness.

It was suspected that the lesion was an epidermoid cyst. The pathologic fracture was recognized as being due to the recent trauma.

Operation was performed on June 13, 1950. The distal phalanx was amputated. Upon elevation of the soft tissue surrounding the bone a white substance was extruded which looked like cold cream. Investigation revealed this substance to be encapsulated in a cyst, the wall of which was a glistening, white, fibrous material. The cyst was readily removed from its nail bed.

FIG. 2. Microscopic section showing the cystic wall. Above this are bony trabeculae, subcutaneous tissue and skin.

Pathologic report of the operative specimen was as follows:* The gross specimen consisted of part of a phalanx including several bits of bone. Under the nail there was a cyst lined by a whitish keratinized membrane measuring .9 by .6 cm. in its greatest dimensions. The cyst was filled with a scaly material.

*The pathologic report was done by Dr. H. Jaffe.

Its wall was thin and showed no induration; the adjacent bone showed pressure erosion. Microscopic examination (Fig. 2), low power, showed an epidermoid inclusion cyst with a keratinized membrane.

The patient made an uneventful recovery. When last heard of one year postoperatively he was working in a defense factory.

SUMMARY

1. The authors have presented a case of cyst of the epidermoid bone of the terminal phalanx in a finger.

2. French, German, English and American literature has been reviewed. Epidermoid cyst of the bone is a rare entity.

3. The entity is seen predominantly in adults, rarely in adolescents and almost never in children. Men are more commonly affected than women, especially those whose work involves trauma such as metal workers, watchmakers and surgeons. The trauma is more apt to be blunt than sharp.

4. Appearance of the lesion following trauma is usually about one year, although the extremes may vary from a few months to as long as thirty-four years. The case reported existed for some time although the symptoms were present for only a few days. The symptoms were due to a pathologic fracture.

5. Theories are discussed, i.e., whether or not the cysts are due to trauma or are of congenital origin.

6. This entity is commonly found in the terminal phalanx although it has been reported in the middle phalanx.

7. Experimental work in the field is described and discussed.

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GASTROCOLIC FISTULA COMPLICATING CARCINOMA*

REPORT OF CASE DUE TO CARCINOMA OF COLON, WITH SUCCESSFUL RESECTION

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GASTROCOLIC fistula is an uncommon complication of carcinoma of the gastrointestinal tract. Because of the extreme state of malnutrition and cachexia seen in patients with advanced malignancy who present this syndrome, the operative mortality to date has been prohibitive. Only five patients surviving resection have been reported. For this reason we wish to add the report of another patient with gastrocolic fistula secondary to carcinoma, who has survived resection.

Incidence and Etiology. Haller was the first to describe gastrocolic fistula in 1775.[1] We have found recorded 156 cases of fistula secondary to carcinoma of the stomach or colon. Before gastroenterostomy was widely used in treating peptic ulcer, gastrocolic fistula was most frequently reported as a complication of advanced tumor or rarely as a complication of benign ulcer. Bec[2] in 1897 classified sixty-two such cases. Of these, forty-three were due to cancer of the stomach or large bowel, twelve to gastric ulcer, five to abscess within the peritoneal cavity, one to tuberculous peritonitis and one to gastric tuberculosis. A study of 501 autopsies for gastric cancer at that time by Brinton[3] showed eleven (2 per cent) with gastrocolic fistula. Following the rise in popularity of gastroenterostomy for ulcer the great majority of gastrocolic and gastrojejunocolic fistulas encountered have followed posterior gastroenterostomy. Very rare causes reported are syphilis, pancreatic tumor, retroperitoneal sarcoma, ulcerative colitis, stomal ulcer following gastric resection and perforated diverticulitis of the colon.[4–7]

Carcinoma of the stomach is a more frequent etiologic factor than carcinoma of the colon. In a series of eighty-four cases Chavannaz[8] found thirty-eight due to gastric cancer and only six due to cancer of the colon. The fistula may result from contiguous growth of the tumor as it penetrates all layers of the adjacent viscus and undergoes necrosis. Chronic ulceration of the primary tumor may also occur with resulting peritoneal reaction, organization of exudate, adherence of adjacent organs and eventual perforation into the lumens of these organs.[9] The communication between the stomach and the colon may be through a wide stoma or through a long narrow tract, usually between the greater curvature of the stomach and the splenic flexure or transverse colon.[10] The tract is usually part of the neoplasm and is lined with tumor cells.

Pathogenesis. The direction of the alimentary flow in these cases has long been a subject of controversy. For many years it was believed that gastric contents were shunted directly into the colon. This short circuiting of the gastrointestinal tract in combination with a marked degree of irritation caused by the gastric juices was thought to be responsible for the serious and rapidly fatal state of malnutrition which occurred. In 1920 Bolton and Trotter[11] observed rapid improvement following cecostomy in a patient with a gastrojejunocolic fistula, and they postulated that the flow was from the colon into the stomach. They were not able to find undigested food or excessive fat in the feces. This theory was supported by Pfeiffer and Kent[12] who noted immediate cessation of diarrhea and improvement of the state of health following proximal colostomy. Other observers (Mathewson,[13] and Barber and Madden[14]) showed that barium meal often failed to enter the fistula while a barium enema almost invariably demonstrated it. Kiskaddon, Templeton and Renshaw[15] reported that in eleven patients studied barium meal passed into the small bowel, but in only two instances did small amounts of barium pass directly through the fistula into the colon. Following barium enema it flowed through the fistulous

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tract into the stomach in all eleven patients. These authors studied seven dogs with surgically created fistulas and concluded that aliment sufficient to maintain nutrition passed into the small intestine while the small amount of food directly shunted into the colon was too insignificant to produce the characteristic syndrome. The regurgitation of colonic contents into the small intestine caused marked derangement of the digestive and absorptive mechanism of the bowel by injury and pathologic changes in the mucosa. Violent peristalsis was initiated causing food to be rapidly moved along the alimentary tract. Barium has been reported to have passed from the upper jejunum to the lower ileum within three minutes.[16] One has only to place a stethescope on the abdomen of the patient to realize the marked degree of hyperperistalsis which is present.

TABLE 1

PREVIOUSLY REPORTED CASES OF GASTROCOLIC FISTULAS SECONDARY TO CARCINOMA IN WHICH PATIENTS SURVIVED SURGICAL RESECTION

Name of Author	Type of Case	Surgical Treatment	End Result and Follow-up
Verbrugge[21]	Carcinoma of colon	Partial gastrectomy with partial colectomy (end-to-end anastomosis)	Died 14 mo. later from recurrent carcinoma and pneumonia
Pfeiffer[16]	Carcinomatous mass involving colon and stomach	Preliminary transverse colostomy; partial gastrectomy and partial colectomy (end-to-end anastomosis)	Uneventful convalescence; no follow-up
Zanca[22]	Carcinoma of colon	Partial gastrectomy and partial colectomy (end-to-end anastomosis)	Good health for 2 mo., postoperative observation
Gabridzhanian[23]	Carcinoma of colon	Local resection of the gastrocolic fistula was apparently done (description not clear)	Died in 3 yr. from a recurrent gastrocolic fistula secondary to tumor
Brunschwig[24]	Carcinoma of colon (splenic flexure)	Primary diverting colocolostomy by another surgeon; sleeve resection of stomach, partial colectomy, partial pancreatectomy, splenectomy and resection of a segment of diaphragm	Good health for 6 wk., postoperative observation

Symptoms. Initial symptoms are referable to the primary disease. Following the development of gastrocolic fistula, however, the devastating syndrome is characterized by foul eructations, weight loss commensurate with the diarrhea, steatorrhea, epigastric distress of varying intensity, dehydration, malnutrition, avitaminosis and anemia. Although diarrhea is usually described as an outstanding symptom, its presence is variable. It may be intermittent or absent altogether and constipation, in fact, may be present. In a review of the literature Mathewson[13] reported that when diarrhea was present, the gastrocolic opening was large or there was some obstruction to the normal flow of gastric contents through the pylorus. On the other hand, in enterocolic or gastrojejunocolic fistulas where a segment of small bowel was involved but was patent distal to the fistula, diarrhea was invariably present. He concluded that diarrhea was the result of a low threshold of irritability of the upper gastrointestinal tract for colonic contents.

Operative Procedures. The mortality reported for radical surgery for advanced carcinoma with gastrocolic fistula has been high, and only five patients were reported as having survived the immediate postoperative period. (Table 1.) However, the abnormal communication between the upper and lower gastrointestinal tract entails such disastrous effects upon body function that treatment is necessary and has little to lose in terms of patient survival. When a cure may be sought by extensive resection, it is surely indicated. Even for palliation the slowly growing lesions of the left colon would seem to merit resection.

In the surgical treatment of gastrojejunocolic fistula secondary to posterior gastroenteros-

tomy done for peptic ulceration, defunctioning colostomy as a preliminary procedure has done much to lower the mortality. It seems even more essential when the pathologic condition is a result of carcinoma. With proximal colostomy there is usually cessation of vomiting and diarrhea if these were present. The appetite returns and the patient gains in weight. Correction of anemia and avitaminosis can be effected. Diversion of the fecal stream also lessens the degree of peritoneal contamination at the second stage procedure, and the inflammatory processes which often accompany the chronic perforation of the neoplasm subside.[12] The objection[14] that preliminary colostomy implies a third operation for closure of the colostomy with subsequent prolonged hospitalization is insignificant when one considers the seriousness of the disease and the almost miraculous improvement which usually follows colostomy. Baker[17] and Hedin[18] advocated ileostomy on the ground that it accomplished the same result while its construction and eventual closure were more easily executed. Lahey et al.,[19,20] by division of the terminal ileum and anastomosis of the proximal segment to the descending colon, diverted the fecal stream well beyond the point of fistula. They believe that this achieves the beneficial effects of proximal colostomy and not only eliminates a future operation for closure of the colostomy but also facilitates radical resection of the entire ascending and transverse colon.

CASE REPORT

C. B. (Boston City Hospital No. 1317232), a seventy-five year old white man, was admitted to the Fourth Medical Service on March 27, 1949, complaining of weakness, postprandial epigastric distress, nausea and vomiting, and 22 pound (10 Kg.) weight loss of six months' duration. There was a slight increase in chronic constipation, and no diarrhea was present.

Physical examination revealed a man in an early state of cachexia who appeared acutely and chronically ill. His temperature was 99.2°F. and pulse 72 (regular rhythm). Blood pressure was 116/48 and weight 117 pounds (56.4 kg.). Cardiovascular system showed only palpable peripheral arteriosclerosis and a long, soft, apical systolic heart murmur. The abdomen demonstrated constantly increased normal-pitched peristaltic sounds. There was vague right upper quadrant tenderness on deep palpation and a smooth, sharp, non-tender liver edge was palpable on deep inspiration. A poorly defined, non-tender, nodular mass was palpable in the left upper quadrant; this descended with respiration. Rectal digital examination demonstrated a symmetrically enlarged, smooth, rubbery prostate.

Laboratory examinations revealed the following: Urine was normal (concentrated as high as 1.023); hemoglobin 5.2 gm., hematocrit 19 per cent, red blood cells 2.0 by 10.6; blood smear showed marked variation in size and shape of erythrocytes with hypochromia; icterus index, 5; non-protein nitrogen, 36; blood Hinton, negative; black stools and coffee ground vomitus guaiac 4 plus, with 6 units of free and 10 of combined acid in the vomited material. Subsequent preoperative studies showed CO_2 combining power of 54 volumes per cent, chlorides 113 mEq./L. and total serum protein of 4.7 gm. per cent; prothrombin was 63 per cent of normal and tourniquet test was negative.

Diagnoses of obstructing carcinoma of the stomach, carcinomatosis from the colon and carcinoma of the pancreas were considered. During twenty-five days of study and preparation before operation the patient received 2,500 ml. of transfused blood with rise of hemoglobin to 10 gm. Upper gastrointestinal x-rays on the thirteenth day showed a 3 cm., rounded, diverticulum-like defect projecting to the left from the mid-greater curvature of the stomach. (Fig. 1), duodenal deformity suggesting healed, scarred duodenal ulcer and rapid gastric emptying. The greater curvature defect was interpreted as possible deep ulceration into the gastric neoplasm. The amount of vomitus was increasing and contained red blood, and the character of both vomitus and eructations became feculent. On the nineteenth day gastroscopic findings were as follows: "On the posterior wall in the middle one-third of the stomach there is the opening (large) of a diverticulum through which fecal-like material extrudes. There is slight evidence of hypertrophic gastritis about this opening. Diverticulum of stomach—? gastrocolic fistula." Barium enema on the same day showed nearly complete obstruction to the passage of barium by an intrinsic tumor of the colon at the splenic flexure. A small amount of barium passed this point and entered the stomach. Accordingly, the diagnosis of carcinoma of the

FIG. 1. Roentgenogram after barium meal shows fistulous tract appearing as a diverticulum-like outpocketing from the greater curvature of the stomach. At this examination barium was not seen to pass into recognizable colon. Examination of the resected specimen showed that the diverticulum pictured here was formed by extensive ulceration into the tumor itself. Barium enema films showed a fine trickle of barium entering the stomach and are not reproduced because of the detailed analysis required for interpretation.

colon with invasion of stomach and gastrocolic fistula was established.

On the twenty-sixth hospital day abdominal exploration revealed a 14 cm. tumor mass binding the splenic flexure of the colon to the posterior mid-portion of the stomach with adherence of the splenic pedicle and tail of pancreas. No nodal or distant metastases were obvious. A transverse Devine type colostomy was made.

During fourteen days between colostomy and resection the patient was able to take only small amounts of food, and vomiting continued to increase in severity. Blood, 2,000 ml., was given and the hemoglobin level was maintained near 10 gm.

On the forty-first hospital day block resection of the tumor mass was done including the lower two-thirds of stomach, the distal transverse and descending colon, the body and tail of pancreas, and spleen. The proximal stomach was anastomosed to the pyloric end and the distal sigmoid was brought out as a mucous fistula through the lower left quadrant of the abdomen.

Pathologic examination revealed a bulky carcinoma of the colon with direct extension to pancreas, hilum of spleen and stomach, and with perforation into the stomach. The fistula was 2 cm. in diameter. The greater omentum was present on the specimen and no involved lymph nodes were found. The margins of removed organs cleared tumor tissue by at least 5 cm. The tumor was thought to be slowly growing by histologic criteria.

After operation the patient was kept on gastric suction intermittently for the first twelve days and maintained on parenteral fluids. At that time a gastrocutaneous fistula was evident, necessitating continuance of gastric suction. Subsequently the patient's condition deteriorated rapidly with mental confusion, muscular weakness and lethargy. Electrocardiograms and flame photometric measurements of serum potassium levels indicated a deficiency state. His response to parenteral potassium salts was dramatic and further recovery continued uneventful.

By the sixty-third hospital day the patient was eating a good diet and had no drainage from the fistula. Following discharge from the hospital he gained 40 pounds (18.2 kg.). On May 8, 1950, right colectomy and ileosigmoidostomy were accomplished without incident. There was no evidence of recurrence of the tumor.

SUMMARY AND CONCLUSIONS

1. Gastrocolic fistula is a rare but disastrous complication to some cases of gastric and colonic cancer.

2. Relative reported incidence from different causes and some rare origins of the lesion are presented briefly. Basic contributions to present understanding of pathogenesis and treatment are cited. Previously reported successful resections for this lesion and for the similar syndrome of duodenocolic fistula are tabulated.

3. Defunctioning colostomy or ileocolostomy seems mandatory and is usually immediately beneficial in these cases. Adequate resection of tumors should be attempted whenever cure may be sought and is probably desirable for palliation of slowly growing tumors of the left colon.

4. The sixth reported case in which a patient survived resection, with a good result and

apparent cure after two years, is described. Etiology was carcinoma of the splenic flexure of the colon.

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SOLITARY DIVERTICULITIS OF THE CECUM

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DIVERTICULITIS of the colon has been known to the literature since 1853 when Virchow[2] pointed out its occurrence in the sigmoid flexure and its less frequent presence in other segments of the colon. Diverticulitis of the cecum, although much less frequent, has been known as an entity since 1912 when Potier[1] described the first recorded case of cecal diverticulitis.

It has been varyingly recorded that diverticulosis of the colon occurs in from 1 to 7 per cent[3,4] of the population but the exact incidence is difficult to estimate because most of the studies which have been reported are based on x-ray findings and, in general, these studies are weighted because the x-rays have been taken on patients already manifesting gastrointestinal symptoms. Diverticulosis of the right colon is even less common than diverticulosis of the left colon and has been said to occur in about 2 per cent of cases in which left-sided colonic diverticula were present.[4,5]

In the other portions of the colon the diverticula are most frequently multiple although solitary diverticulum has been described. In the cecum these diverticula are almost always solitary, and in all the cases previously reported and the cases presented herein it has been the rule to find only a single diverticulum. A few cases are reported in which there were associated diverticula in the ascending colon or even in the transverse or descending colon, but the cecum itself in almost every case contained only one diverticulum.

Cecal diverticulitis is exceedingly uncommon, and until 1947 when Anderson[6] reviewed the literature and added nine cases of his own from the Mayo Clinic the total of reported cases was 100.[7–9] Since his comprehensive review there have been twenty-six additional cases in the literature.[10–15] Six cases have been seen on the Surgical Services of The Mount Sinai Hospital since 1933, bringing the total number to 132.

Clinical Features. In colonic diverticula complications such as perforation, peritonitis, abscess formation, fistulization and obstruction produce the clinical problems. Similarly, the complications of cecal diverticula produce the symptomatology and necessitate surgical intervention. In the majority of cecal cases it is diverticulitis *per se* which causes the symptoms. However, perforation of a diverticulum has been described six times and perforation with peritonitis twice. Gangrene of the diverticulum was seen on two occasions. Intestinal obstruction, a frequent complication of sigmoid diverticulitis, has never been reported. This is probably due to the large size of the cecum and to the fact that an inflammatory process in one part of its wall will therefore not occlude the intestinal lumen. In one instance a fistula between the terminal ileum and the diverticulum was noted. This was found in the third case of our own series. The details of these pathologic findings and other associated factors are found in Table I.

Etiology. The etiology of cecal diverticula is unknown and the process which produces the diverticulitis can only be postulated. In the vast majority of cases in which there was still sufficient tissue to identify the diverticular wall, these diverticula represented true diverticula, i.e., their wall was composed of all layers, mucosa, muscularis and serosa. Greensfelder and Hiller[16] suggest traction from adhesions or trauma to the cecum as a possible factor in the creation of cecal diverticula. However, this would explain only those cases in which previous surgery had been performed and would not explain the reason for the onset of inflammation. Waugh[17] raises the possibility of appendix duplex as an explanation for the presence of the diverticula. Stagnation of fecal matter in the diverticulum and ulceration of the mucosa may be an initiating factor in producing the diverticulitis. Obstruction by a fecalith has been found in an occasional case and may be the precipitating cause. Although any of these may be correct, the exact mechanism has not been clarified to this date. (Table II.)

Differential Diagnosis. Cecal diverticulitis is an important clinical entity because of its

extreme similarity and mimicry of acute appendicitis. In Anderson's series 84 per cent of the cases reported were diagnosed preoperatively as some form of acute appendicitis and only 6 per cent were recorded as having a correct preoperative diagnosis. Acute appendicitis in some form was the diagnosis in all but three cases since Anderson's article, including our series. Therefore it is clear that in spite of the many recent surgical advances our diagnostic acumen has not progressed sufficiently to permit us to distinguish between the two diseases.

Preoperatively this confusion with acute appendicitis is largely academic because in most instances the patient will be explored in any event. However, once within the abdomen, the choice of therapy becomes paramount and here cecal diverticulitis must be distinguished from other diseases of the cecum in order that the proper procedure may be elected. Most important is the differentiation from cecal carcinoma. In the presence of a large amount of inflammation and induration the similarity may be marked and the frequency with which hemicolectomy has been performed, on the assumption that carcinoma was present (twenty-six of 132 cases), indicates how difficult the differentiation may be. (Table II.) Even with the aid of frozen sections such differentiation may still be extremely difficult if the site of the biopsy happens to enter inflammatory tissue at the periphery of a neoplasm.

Ulcerative colitis, terminal ileitis, tuberculosis and actinomycosis are other conditions producing inflammatory masses in the cecum but these are more readily identified by history and by the local pathologic condition. Simple ulcer of the cecum is a condition of unknown etiology which occurs even less frequently than solitary diverticulitis of the cecum but can be

TABLE I

FEATURES OF INTEREST IN CASES OF CECAL DIVERTICULITIS FROM THE SURGICAL SERVICES OF MOUNT SINAI HOSPITAL, 1933–1952

Hospital No.	Age and Sex	Procedure	Preoperative Diagnosis	Postoperative Findings	Result
455457	60, F	Ileocolostomy with exclusion; appendectomy and closure of perforation	Appendiceal abscess	Perforated diverticulum and abscess	Died 8th postoperative day
355765	64, M	Ileocolic resection; ileoileostomy	Periappendiceal stump abscess or neoplasm	Cecal diverticulitis; ileocecal fistula	Died 16th postoperative day
435850	32, M	Diverticulectomy and appendectomy	Acute appendicitis	Gangrenous cecal diverticulum	Improved
513411	56, F	Ileocolic resection	Acute appendicitis	Gangrenous cecal diverticulum	Improved
630837	28, F	Cecotomy and appendectomy	Acute appendicitis	Cecal diverticulitis	Improved
616376	52, M	Diverticulectomy	Appendiceal stump abscess; cecal diverticulitis	Cecal diverticulitis	Improved

TABLE II

TYPES OF OPERATIVE PROCEDURE

Procedure	Anderson's Series	Cases in Literature since 1947	Author's Series
Diverticulectomy	53		
Diverticulectomy and appendectomy	0	5	1
Right colectomy	18	3	3
Cecectomy	14	1	0
Drainage	5	0	0
Closure of defect	3	0	0
Exteriorization	2	0	0
Ileocolostomy with exclusion	0	0	1
Cecotomy and appendectomy	0	0	1
Ileostomy	0	1	0
Appendicostomy	0	1	0

confused readily.[18,19] These ulcers, likened by some to duodenal ulcer, are almost always on the medial wall of the cecum just distal to the ileocecal valve, whereas the diverticula of the cecum, although they may occur on the medial wall, most frequently are located on the lateral or anterior wall. (Table III.)

TABLE III
LOCATION OF CECAL DIVERTICULA

Position	Anderson's Series	Cases in Literature since 1947	Author's Series	Total
Lateral	15	3	1	19
Anterior	8	3	2	13
Posterior	5	1	0	6
Medial	5	0	1	6
Anterolateral	2	0	0	2
Posterolateral	2	1	0	3
Anteromedial	1	1	1	3

In cases in which the exact diagnosis is not clear grossly, cecotomy is a valuable maneuver and should be performed in order to see the mucosal side of the lesion in question. Often the diverticular orifice will be easily demonstrable and the diagnosis then becomes self-evident.

CASE REPORTS

Following are brief résumés of the cases in our series:

CASE I. (No. 455457.) This patient was a sixty year old white woman who entered the hospital with complaints of generalized abdominal pain and fever for three or four days before admission. Physical examination revealed temperature of 101°F., pulse 88, respiration 20 and blood pressure 140/60. Examination of the abdomen revealed a tender mass in the right lower quadrant and generalized abdominal tenderness. There were no other abnormalities. White blood count was 10,500, with 76 per cent polymorphonuclear leukocytes. Urine showed no abnormality. On April 20, 1940, the patient was explored through a right lower rectus incision. A normal appendix was removed. On the lateral cecal wall there was an inflammatory mass surrounding a perforated cecal diverticulum. This was entered during the dissection and after closure and drainage of the area. Ileotransverse colostomy with exclusion was performed in order to prevent further contamination from the area of the diverticulum. Postoperatively the patient did poorly; severe toxic psychosis developed and she died on the eighth postoperative day. At autopsy the cause of death was found to be peritonitis due to dehiscence of the suture line at the site of the closure of the cecal perforation. In addition to the solitary cecal diverticulum there were several diverticula in the ascending and descending colon.

CASE II. (No. 355765.) This was the first admission of a sixty-four year old white man who had a previous appendectomy and cholecystectomy. During the six months before admission he had had three attacks of severe lower abdominal pain without fever. Following the last attack one week before admission the pain persisted and there was tenderness in the right lower quadrant. On admission a mass which was somewhat tender was palpated in the right lower quadrant. Preoperative barium enema showed a defect in the cecum but opinion was divided as to whether this represented a neoplasm or periappendiceal abscess. White blood count was 8,500, with 68 per cent polymorphonuclear leukocytes. Stools were guaiac negative. On August 17, 1933, the patient was explored through a right lower rectus incision. The right lower quadrant was the seat of an abscess. A fistula between the terminal ileum and the cecum was also demonstrated. This was divided, the opening in the ileum closed and a side-to-side ileo-ileostomy performed proximal to this closure. An ileocolic resection distal to this area was then performed. The pathologic report revealed diverticulitis of the cecum with a fistula into the terminal ileum. Postoperatively the patient did well for about a week, after which bilateral bronchopneumonia developed. He died on the sixteenth postoperative day. No autopsy was obtained.

CASE III. (No. 435850.) This was the first admission of a thirty-two year old man in whom generalized abdominal pain developed twenty-four hours before admission. The pain went into the right lower quadrant ten hours before admission. He was nauseated but did not vomit. Physical examination revealed a temperature of 100.6°F., pulse 100, respiration 32 and blood pressure 104/50. On abdominal examination there was moderate tenderness and voluntary spasm in the right lower quadrant. There was no rebound tenderness

and no masses were palpable. There were no other pertinent findings. On February 5, 1939, the patient was explored through a right lower rectus incision. A normal atrophic appendix was found adherent to a small anterior cecal inflammatory mass composed of a gangrenous diverticulum coming out of the anterior taenia. The diverticulum was excised and the base inverted into the cecum. A routine appendectomy was also performed. The patient had an uncomplicated postoperative course and was followed up for two years, during which time he remained asymptomatic.

CASE IV. (No. 513411.) This was the first admission of a fifty-six year old woman who, six days prior to admission, took a laxative because of constipation and shortly after noted sharp right lower quadrant pain which persisted and increased in severity until admission. She was anorectic but did not vomit and had no bowel movement for six days. Physical examination revealed a temperature of 100°F., pulse 86, respiration 20 and blood pressure 164/94. Her abdomen was soft but there was severe, diffuse right lower tenderness and a questionable mass in the right lower quadrant. There was slight rebound tenderness in the right lower quadrant. White blood count was 18,000, with 73 per cent polymorphonuclear leukocytes. Urine was normal except for mild glycosuria. On November 22, 1943, the patient was explored through a right lower rectus incision, and opposite the ileocecal valve an inflammatory mass the size of a silver dollar was found. Because of the suspicion that the mass might be neoplastic, an ileocolic resection was performed. The pathologic report revealed acute gangrenous cecal diverticulitis in a solitary cecal diverticulum and a normal appendix, ileum and colon. Postoperatively the patient did well except for mild phlebothrombosis which subsided under conservative therapy. Postoperative barium enema showed no other diverticula. She was followed up for two years and remained asymptomatic.

CASE V. (No. 630837.) This was the first admission of a twenty-eight year old Negress with a twenty-four-hour history of crampy, lower abdominal pain which shifted to the right lower quadrant twelve hours before admission. There was no nausea, vomiting or change in bowel habits. She was eight months postpartum and had been nursing her child up to the time of her admission. Physical examination revealed a temperature of 98.8°F., pulse 64, respiration 20 and blood pressure 116/74. Her abdomen was soft and there was direct, referred and rebound tenderness in the right lower quadrant. A mass was felt by some observers in the right lower quadrant. The remainder of the physical examination was non-contributory. White blood count was 16,700. Urinalysis was negative. On September 12, 1951, the patient was explored through a right McBurney incision. The cecum had an inflammatory mass on its anteromedial aspect. Because the exact nature of the lesion could not be determined, a cecotomy was performed and a diverticular opening demonstrated. Diverticulectomy was not performed because it was believed that spontaneous subsidence of the inflammation would occur. Appendectomy was performed and the appendix showed only periappendicitis. Because of persistent low grade fever and failure of the right lower quadrant mass to resolve, the patient was given a course of sulfasuxidine (4 gm. four times daily) for five days. On this regimen her temperature returned to normal and the mass resolved. At follow-up five months postoperatively she was found to be asymptomatic.

CASE VI. (No. 616376.)* This fifty-two year old man was admitted eight months after having been operated upon for acute gangrenous appendicitis. At that time an appendectomy using the ligature and drop technic was performed. There was no evidence of a cecal diverticulum at this operation. Two days before the second admission he began to have crampy right lower quadrant pain. Physical examination on admission revealed a temperature of 99°F., pulse 80, respiration 20 and blood pressure 115/70. Examination of the abdomen showed the presence of a tender, orange-sized mass in the right lower quadrant and the remainder of the abdomen was soft and nontender. The rest of the examination was noncontributory. White blood count was 11,100 with 73 per cent polymorphonuclear leukocytes and the urine was negative. X-rays were suggestive of a foreign body in the right lower quadrant and a barium enema was reported as showing a small trickle of barium leaving the confines of the cecal wall. The patient was explored on September 29, 1950. There was an inflammatory mass in the region of the ileo-

*This case is being published elsewhere by Dr. Edward Jemerin of Mount Sinai Hospital.

cecal juncture. This was found to surround a solitary cecal diverticulum on the anterior cecal wall. No appendix stump was seen; and since no diverticulum was seen at the time of the first operation, it is possible that some trauma to the cecum at that time might be implicated as the cause of this diverticulum. The diverticulum was excised and the cecum closed in two layers. The patient did well postoperatively and has had no symptoms of recurrence.

COMMENTS

Analysis of these cases reveals several things of interest. The age distribution of the patients is the same as in the previously reported cases, ranging from twenty-eight to sixty-four years. The sex distribution was also similar, males and females occurring in equal frequency. All of the cases were suspected to have acute appendicitis except for those who had had a previous appendectomy, and those cases were thought to have an inflammatory process related to the appendiceal stump. There was one case, that of Costin and Gaston (Table I) in which a diagnosis of carcinoma of the cecum was made. This was entertained because of the suspicious picture seen on a preoperative barium enema. In this case it was necessary to perform ileocolic resection because the cecal mass found at operation could not be distinguished from carcinoma. Only the pathologist could identify the whole process as cecal diverticulitis. The pathologic findings in Case II are unusual. This case represents the only one reported in which fistulization has been described. The two deaths in our series were in patients who were seriously ill and who died of peritonitis before the time when antibiotics were available. Both of these patients had ileocolic resections and this emphasizes the point that a major procedure such as this should be viewed with disfavor for a benign process like cecal diverticulitis.

CONCLUSIONS

From the foregoing it can be seen that diverticulitis of the cecum, although uncommon, is a clinical condition worthy of mention because of its frequent confusion with acute appendicitis and because of the problem in therapy which it poses. At the present time it would seem that the procedure of choice is diverticulectomy. Incidental appendectomy can be performed at the same time with little added risk since the cecum will already have been opened in the performance of the diverticulectomy. The choice of using or not using this procedure must rest with the preference of the individual surgeon. Ileocolic resection should be reserved for cases in which carcinoma of the cecum cannot be ruled out at the operating table. If the diverticulum is very close to the ileocecal valve and excision might compromise the patency of this structure, simple drainage of the inflamed area may be adequate. In the occasional case in which such a situation may be found, one may elect to do an ileocolic resection if the patient's general status and anatomic configuration will make this a safe procedure in the face of unprepared bowel. The antibiotics now in vogue should be used in the event that peritonitis is also present, although once the focus of infection has been removed, the body will readily cope with the infection in most cases. The prognosis is uniformly good after the immediate postoperative period and recurrences are not recorded.

SUMMARY

1. A review of the literature concerning cecal diverticulitis since 1947 with the addition of six cases from the Surgical Services of Mount Sinai Hospital, is presented.

2. The similarity of this disease and acute appendicitis, and the other interesting clinical features are discussed.

3. Diverticulectomy is considered to be the treatment of choice.

Acknowledgment: The author wishes to extend his thanks to Dr. Arthur S. W. Touroff, Dr. John H. Garlock and Dr. Ralph Colp for permission to use the cases from their respective services. Gratitude is also expressed to Dr. Edward Jemerin for permission to use Case IV which he is presenting elsewhere, and to Dr. Louis Lester for his invaluable help in the preparation of this paper.

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One group in Norway now treats early cases of cancer of the cervix with radium, and after two months they perform a "prophylactic hysterectomy." This is not a Wertheim operation but a simple, total enucleation of the uterus. Specimens removed showed a positive biopsy in one-fifth of the cases. Presumably many of these latter would eventually develop local recurrences or metastases. It is for this reason the doctors call this procedure prophylactic hysterectomy. Only time will tell whether or not this combined method is going to improve our statistics in cervical cancer. (*Richard A. Leonardo, M.D.*)

Modern Operative Technics

No. 13

RHYTIDOPLASTY

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THE purpose of this article is to present an illustrated step technic for rhytidoplasty which might be followed as a more or less standard procedure disregarding the numerous minimal individual variations. A review of the preoperative preparation of the patient will be included for completeness.

Before the patient is brought to the operating room, the face and neck are thoroughly washed so that all traces of cosmetics have been removed. The hair must be cut anterior of and above the auricle for about 2 cm. leaving any remaining hair long. The hair in the postauricular area should be shaved approximately 1 cm. above the mid-auricular line. The remaining hair must be fastened up out of the operative field in one or another of the following methods: The hair may be held up with adhesive tape fastened just above the shaved areas to hold the hair away from the ears. If it is preferred that adhesive tape not be used, the hair can be held up with a type of rubber cap similar to a bathing cap. Bandaging the head may also aid in keeping the hair out of the operative field. However, none of these methods are as satisfactory as the use of adhesive tape itself. It is almost impossible to keep the field entirely free of hair. This is particularly true in women by whom staunch objection will be made even to the aforementioned preparation. In men there is much less of a problem. It should be realized that surgery must be performed in a relatively contaminated field. This relative contamination by the hair may be combatted by frequent applications of antiseptic solutions to the hairy areas and by the prophylactic use of antibiotics. The antiseptic solution used here, as in any other skin wash, should be of a colorless or untinted variety. It is always well not to camouflage skin color with tinted preparations.

Preoperative medications are employed according to the type of anesthesia. Although either local or general anesthesias may be used, local anesthesia is most efficacious and eliminates the hazards of a general anesthesia. If a local conduction anesthesia is to be used, it is well to have the patient arrive in the operating theater in a deeply narcotized state. This may be accomplished with 3 gr. of a barbiturate such as nembutal,® seconal or amytal given orally one and a half to two hours before the surgery, supplemented by morphine sulfate, $\frac{1}{4}$ and/or $\frac{1}{6}$ gr., and scopolamine, $\frac{1}{150}$ gr. one-half hour before surgery.

When the well narcotized patient comes into the operating theater, the surgeon should carefully check the operative field to assure himself that sufficient hair has been removed and that the remaining hair is held out of the field as much as it is possible. The area is cleaned with liquid soap, rinsed with water and cleansed with alcohol. This is followed with an application of any one of the acceptable antiseptics such as colorless aqueous solution of zephiran. All soap must be carefully removed as traces will jeopardize the antiseptic's value. This preparation is usually done by the assistant or, if desired, by the surgeon before he has prepared himself for surgery. It is well to remember that it is necessary to consume as much time scrubbing the face as would be used in the preoperative scrubbing of the hands. It is always well to place a short piece of $\frac{1}{2}$ inch gauze packing or cotton into the external auditory canal before the preparation of the face. This is replaced with a fresh piece at the time of draping and remains throughout the operation to prevent blood from collecting in the deeper recesses of the external auditory canal. Accumulations of blood in the eyes or ears lead to very annoying postoperative

complications. The patient is draped with the usual head and body drapes.

The anesthesia, if induced by the local infiltration method, is begun in the preauricular region with the use of a 25 gauge 5/8 inch needle. Either monocaine, xylocaine or procaine may be used. As a large quantity of the anesthetic agent will be needed, it is well to use not more than a 1 per cent solution to which epinephrine (1:100,000) has been added. This is an ideal situation in which to use hyaluronidase (150 units to 25 cc. of anesthetic solution) as it diminishes the quantity of anesthetic solution required. The peau d'orange infiltration is effected along the line of the incision. Through this anesthetized area 2 to 3 inch needles are used to anesthetize the skin to the lateral canthus of the eye, the full cheek to the nasolabial fold, the oral canthus and the mid-mental region. The neck is anesthetized to the midline submentally and well down along the neck 5 to 6 cm. The whole postauricular shaven area is anesthetized in the same manner. The helix of the auricle is anesthetized so that it may be retracted with hooks during the operation.

Following the anesthetization of the cheek there is usually temporary facial palsy. This is evidenced not at the time of infiltration but somewhat later. This should cause no concern on the part of the surgeon for he should have not involved the tissue deeply enough to injure any of the branches of facial nerve.

OPERATIVE PROCEDURE

Incision. Incision is begun in the temporal region superior to the preauricular area about 2 cm. It is brought down to the superior meloauricular fold across the crus of the helix in the small fold that is usually present at this junction, along the inner edge of the crus of the helix, into the supratragal incisure, along the inner edge of the tragus, out onto the meloauricular fold at the intertragal notch, along the fold in front of the lobe around posterior following the attachment of the lobe into the postauricular region. The incision extends cephalad just posterior to the postcephaloauricular fold up to a point horizontally opposite the upper limits of the tragus where it curves in a graceful arc posteriorly onto the nape of the neck until it has reached a point about 1 cm. above the level of the lobe of the ear. The tip end of the incision should curve upward as this will enhance the closure. At no point along the incision should an angle occur. This is particularly true posteriorly when the incision leaves the immediate postauricular area and swings out onto the head. The exposure for the postauricular incision is enhanced by drawing the auricle forward with a couple of skin hooks. (Fig. 1.)

Undermining. The skin is undermined through the superficial subcutaneous layers to within a short distance of the lateral canthus of the eye and along a line extending from the point near the nasolabial fold and the oral canthus. If the chin is heavy or wrinkled, the infralabial or mental region may be undermined. The neck is undermined from the submental region well down onto the neck and around to the postauricular incision. This describes extreme limits of undermining and frequently they may be less as it varies with the case. The undermining may be done with a scalpel but blunt dissection with scissors is preferable as there is less hemorrhage. The skin must never be split as there is a possibility of slough wherever epidermis is pulled over areas capable of producing epidermis. The undermining is not carried deeper than the immediate subcutaneous level as there is danger of involvement of a branch of the facial nerve. The depth of undermining is slightly deeper under hair-bearing skin so that the hair follicles are not injured; this is especially true in males. If the undermining is deep, more hemorrhage will occur because in the deeper subcutaneous tissue larger vessels will be opened. The minimal hemorrhage that occurs is controlled by wet, hot saline sponges. There is rarely any necessity for the ligation of bleeding points. If some oozing exits, the bleeding point may be coagulated with electrocoagulation. However, all bleeding must be controlled as dangerous postoperative sequelae may occur. Collections of blood in the neck may cause asphyxiation due to pressure on the trachea. Elsewhere the blood clots are ideal media for a nidus of infection. Special care should be taken in the neck region over the sternocleidomastoid muscle as a luxuriant venous plexus is very superficial. If complete hemostasis is effected, there is no indication for the use of drains. (Fig. 2.)

Stretching Technic. The freed skin is drawn backward over the auricle until the desired tension has been acquired. This is gauged by the close observation of the palpebral and oral fissures. Tension may be applied until the

onset of distortion at either or both of these points. No further tension is permissible. This tension is best applied by attaching two Allis clamps to the skin edge, one at the level of the crus of the helix and one in the post-auricular region where the incision swings away from the ear. These clamps are pulled upward and backward at approximately a 60 degree angle. The angle of pull on the posterior clamp is a little greater than that on the anterior clamp. At this point the auricle is nearly covered with the facial skin. An on-end mattress suture of No. 3-0 braided black silk is placed postauricularly where the incision swings out over the neck. This is the major posterior retention suture, as it maintains the skin tension. A third Allis clamp is applied at the level of the intratragal notch. It is pulled upward and backward parallel to the first anterior clamp. The skin is incised with a scissor from its free border anteriorly to the level of the incision at the supratragal notch. A second silk suture is placed here. (Fig. 3.)

Excision of Skin. The redundant skin between the two preauricular sutures is cut carefully following the line of the original incision. No further tension is applied at this point. The edges are sutured with well spaced simple sutures of No. 6-0 surgical nylon. (Fig. 4.)

Above this area the redundant skin takes a generally triangular shape. This is now excised again following the outline of the original incision. Well spaced simple sutures of No. 6-0 surgical nylon again approximate the edges. (Fig. 5.)

1

2

FIG. 1. The incision. Dotted line indicates extent of undermining. FIG. 2. The undermining procedure.

Inferior to the previous two areas is another roughly triangular portion of skin that is to be excised. Care must be exercised at the lower reaches of this excision as the cut must pass just below the lobe of the auricle and into the postauricular area. If too much skin is removed at this point, the lobe of the auricle is apt to be pulled down out of position. Usually there is very little redundant skin to be removed in the postauricular cephaloauricular fold. The edges are approximated with single sutures of No. 6-0 surgical nylon. It is essential to evert the skin edges carefully along the lobe in order to retain a normal ear. This is especially true in women as they will undoubtedly wish to wear earrings later.

An Allis clamp is now placed halfway between the posterior retention suture and the end of the original incision. The redundant skin is removed after an incision at its mid-point. The two triangles are then excised. The remaining skin edges are approximated with No. 6-0 nylon sutures. (Figs. 6 to 8.)

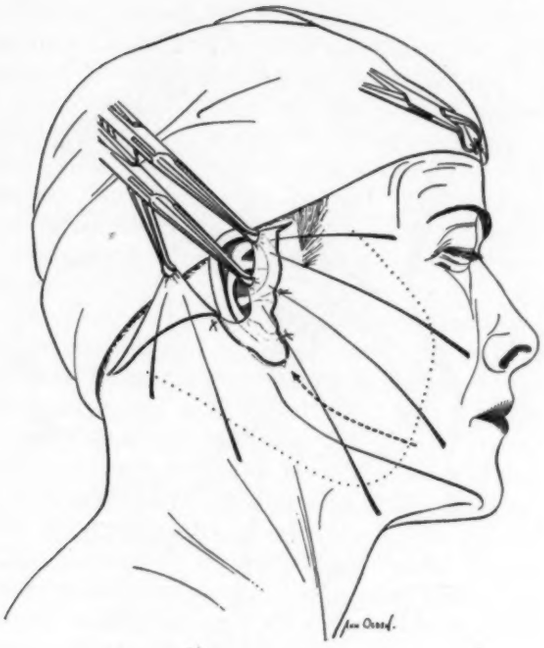

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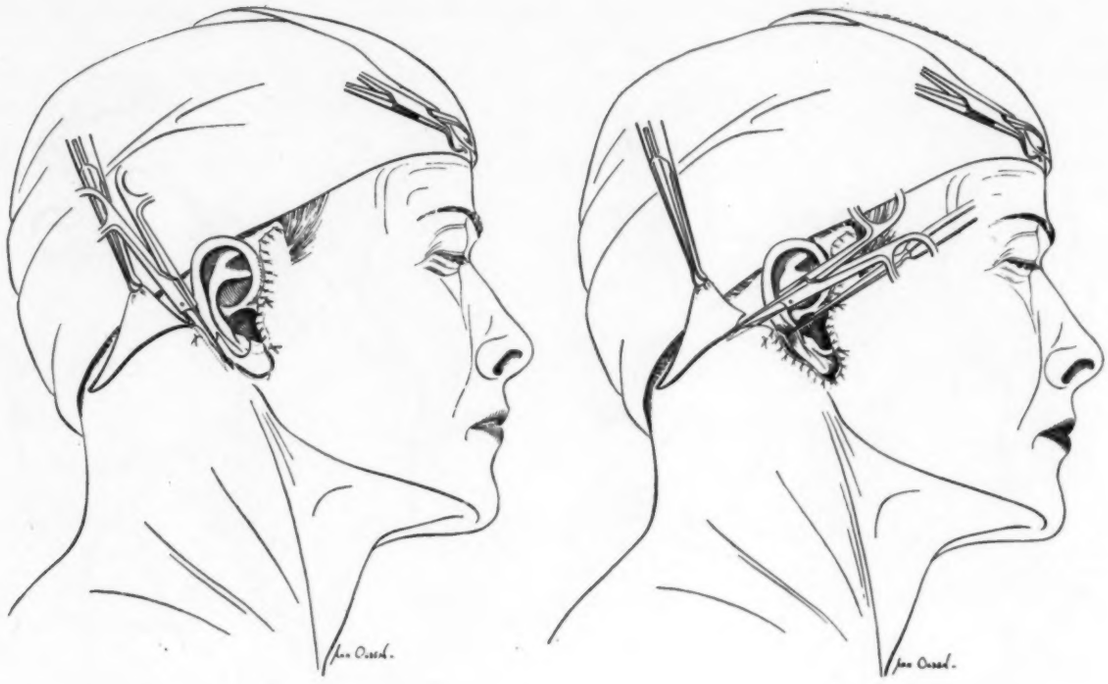
FIG. 3. Retention sutures to support the repositioned skin. FIG. 4. Initial skin excision. FIG. 5. The skin excision continued. FIG. 6. Excision of the remaining preauricular skin.



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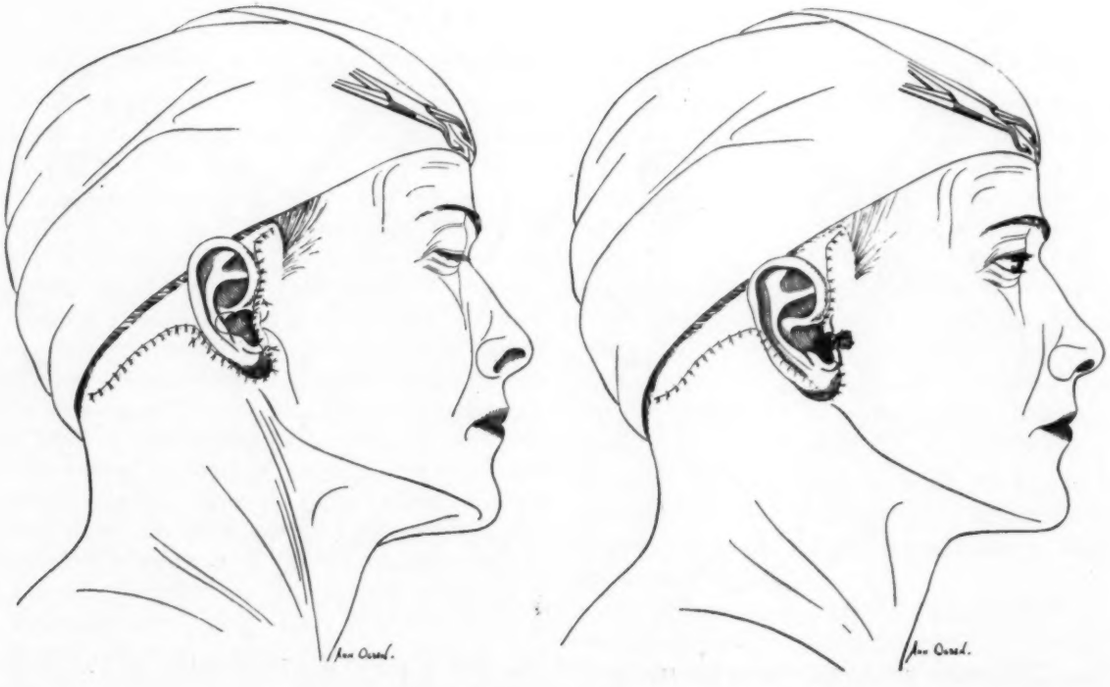

9 10

FIG. 7. Preauricular suture and excision of skin about lower ear. FIG. 8. Excision of postauricular skin. FIG. 9. Introduction of a through and through mattress suture to create the pretragal fold. FIG. 10. Complete operation.

Special Thagal Suture. At this time attention is returned to the pretragal region. At this point a through and through mattress suture is inserted from the skin through the tragal cartilage and the lining of the external auditory canal. The suture is tied over a small piece of gauze. This forms the normal fold that is usually present at this point. This suture is placed about 1 cm. from the edge of the tragal border. (Fig. 9.)

Suturing. The sutures of No. 6-0 surgical nylon are placed closely along the entire incision. These are simple sutures placed so that the skin edges are slightly everted. This is accomplished by inserting the needle at an angle just to the skin surface. The knot is tied close to the skin on either side of the incision. The most difficult sutures are those placed along the tragus as they are actually in the external auditory canal. The skin at this point is very friable and care must be taken that the needle does not tear the tissues. (Fig. 10.)

Dressing. The skin of the face and neck is rolled with a sponge toward the incision to extract any blood that may have collected beneath the skin. The gauze packing is removed from the external auditory canal. The area is inspected for any blood that might have collected. A fresh gauze packing strip is placed lightly into the canal. The incision is covered with lightly impregnated vaseline gauze or similarly impregnated gauze such as furacin® or zerofoam gauze. A folded towel is placed over the side and the head is turned so that the other side may be operated upon. After both sides are completed, fluffed gauze is laid over this gauze and held in place by bandage, plain or elastic. Ice bags to the face help control postoperative edema. The bandage is left in place for about three days. Sutures are removed at intervals of five, seven and ten days. Those which might leave suture marks are removed first, especially if there is no tension. Others may be removed less hurriedly.

There is a tautness of the face after the swelling has subsided which is particularly noticeable from the tenth to the fourteenth day. The swelling of the face will be present for three weeks to one month, depending upon the amount of undermining accomplished an/or the vagaries of the individual.

Practical Surgical Suggestions

USE OF AN ENDOTRACHEAL INFLATABLE CUFF IN TREATMENT OF ESOPHAGOTRACHEAL FISTULAS AND IN ROUTINE TRACHEOTOMIES*

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ESOPHAGOTRACHEAL fistulas are not rare, and when they occur, are a great source of annoyance and discomfort to the patient. The patient is unable to eat; the drainage from the pharynx runs down into the trachea, resulting in severe coughing spasms almost to the point of exhaustion. The ordinary routine packing of the fistula with vaseline gauze does not always prevent pharyngeal drainage from getting into the trachea and healing time is also considerably delayed. It is for this reason that our cases are being presented. There is also the therapeutic possibility of the endotracheal cuff method being of considerable value in bulbar poliomyelitis and in head injuries where the patient has constant drainage of saliva and mucus into the trachea.

In our cases tracheotomies were indicated as therapeutic and diagnostic measures, and in each case the excessive secretions resulted in *partial* obstruction of the respiratory airway. Standard Jackson tracheal tubes and inflatable endotracheal cuffs were used. These cuffs were placed on the distal ends of the Jackson tubes and the corners of the cuffs were anchored with rubber cement. To facilitate the introduction of the cuffed tube, the usual tracheotomy was modified by the excision of a section from each of two tracheal rings. This cuffed tube was then introduced and the cuff inflated with 5 to 8 cc. of air and clamped with a small forceps. If coughing occurred after insertion of the tube and inflation of the balloon, a few minims of 1 per cent pontocaine was allowed to run down the side of the tracheotomy tube. In order to minimize the effects of pressure on the trachea the balloon was deflated for ten minutes every four hours. Aspirated material which collected *above* the cuff was removed periodically by suction applied to a No. 16 French catheter. The tracheobronchial tree below the cuff was aspirated through the breathing tube as often as was necessary. The seal between the balloon on the trachea was not fluid-tight and permitted the passage of small amounts of materials distalward. Also, some aspiration occurred during the deflation periods. However, the amount of serous aspiration was greatly reduced. Thorough suctioning above the balloon was carried out prior to deflation of the balloon to prevent sudden release of a large quantity of aspirate pooled above. The tube was removed daily for cleaning and resterilization.

This modified tracheal tube has been used advantageously in three patients: one with bulbar poliomyelitis who manifested the serious sequelae of the aspiration of secretions; one with a tracheoesophageal fistula where drainage of secretions from the fistula down the trachea resulted in almost continuous coughing and the patient was unable to eat; and the third, a patient upon whom tracheotomy was performed for carcinoma and there was a marked overflow of secretions into the trachea because of involvement of the upper esophagus by carcinoma.

The following cases illustrate the modified tube in use:

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Reviewed in the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the authors are the results of their own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

CASE REPORTS

CASE 1. F. C. H. (admission No. 6391), a fifty-three year old white man entered the hospital on January 31, 1951, with the chief complaint of progressive hoarseness. Examination of the larynx revealed the presence of a large tumor and biopsy established the diagnosis of well differentiated squamous cell carcinoma of the larynx. Therefore, total laryngectomy was performed under general anesthesia.

The postoperative course was relatively uneventful until the eighth postoperative day when, after drinking a milkshake, the patient passed some clotted milk through the incision on the left side of the neck. The diagnosis of a pharongeal fistula was made. The following day, while the dressings and tracheotomy tube were being changed, a copious amount of mucous drainage was noted from the tracheotomy. The lungs, however, were clear. A Levin tube was inserted into the stomach for feeding purposes. The following day there was a considerable amount of drainage into the trachea from the pharynx through the now necrotic part of the trachea. A vaseline gauze pack was placed into the small cavity in the upper portion of the trachea from which the drainage had been coming. Two days later the necrotic pocket above the trachea was seen to be enlarging and a great deal of mucus was running into the trachea. It was obvious that the vaseline gauze pack was ineffective in preventing drainage into the trachea. The patient was quite uncomfortable, coughing almost continuously and bringing up the mucoid material that was running down the trachea from the fistula. The patient was unable to eat.

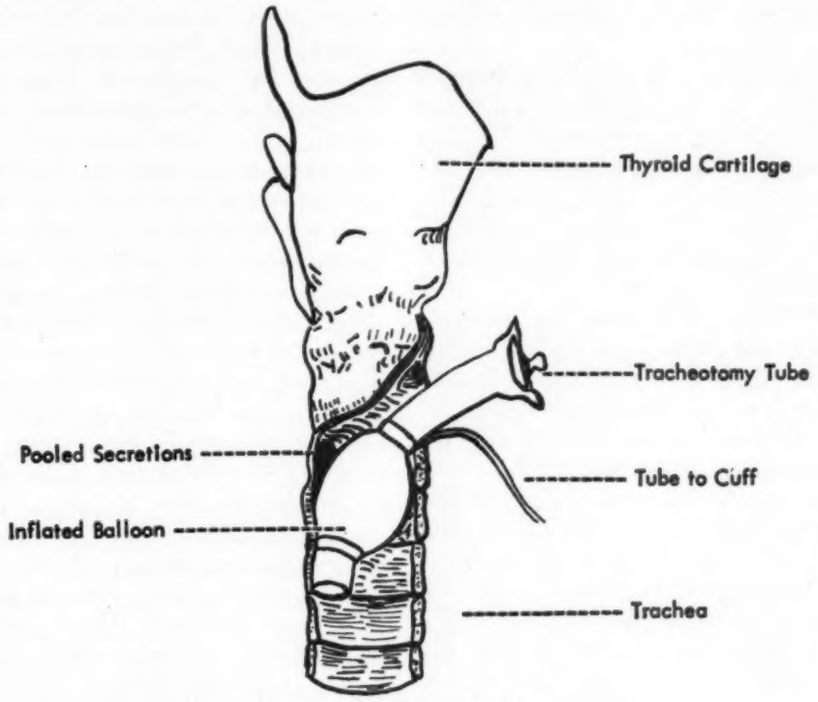

FIG. 1. Cuffed tube in place.

The following day showed no improvement although the patient had been on postural drainage for twenty-four hours. After forty-eight hours of postural drainage the patient was still no better. In fact, he showed great fatigue from constant coughing and lack of sleep.

An inflatable endotracheal cuff was then placed on the No. 8 laryngectomy tube and the tube reinserted. (Fig. 1.) Eight cubic centimeters of air were used to inflate the cuff. A small vaseline gauze pack was also placed in the fistula. Following this procedure the patient's condition rapidly improved; his coughing spasms subsided and drainage into the trachea ceased although copious amounts kept draining externally. The laryngectomy tube and cuff were changed daily, usually early in the morning because the cuff of the tracheotomy tube had spontaneously deflated during

the night and the patient was experiencing coughing spasms. However, after reinsertion of a clean cuffed tube the spasms subsided and the patient appeared quite comfortable.

From that time on the fistula gradually closed until on the thirtieth postoperative day the cuffed No. 8 laryngectomy tube was removed and a No. 10 was inserted without a cuff.

The patient was now able to manage himself without a cuff on the laryngectomy tube and to care for his tracheotomy himself. He was therefore discharged from the hospital and told to return in two weeks, at which time it was found that the fistula had entirely closed. The patient did not experience any difficulties in eating a regular diet thereafter.

CASE II. R. T. C. (Admission No. 10,059), a thirty-one year old white man, was admitted to this hospital with a diagnosis of bulbar poliomyelitis, with symptoms of six days' duration. He had difficulty in swallowing and regurgitated food through his nose. There was considerable accumulation of secretions in the oropharynx. The patient began to aspirate oral secretions because of his inability to swallow. Tracheotomy was performed and a No. 6 tracheotomy tube was inserted, no cuff being placed on the tube at this time. Because of the patient's very poor voluntary chest movements he was put in a respirator. The tracheobronchial tree continued to be flooded with secretions and the routine suctioning was of little help in keeping the tracheobronchial tree dry. Bronchoscopies were performed daily and large amounts of mucopurulent discharge were removed. The tracheotomy tube was then replaced by a No. 6 tube with an endotracheal cuff in order to seal off the trachea from the pharyngeal secretions. The cuffed tracheotomy tube functioned so well that very little or no drainage appeared below it and the small amount of secretion that formed *above* was easily removed by catheter suction. Bronchoscopy five days later showed the tracheobronchial tree to be free from secretions. The following day the patient's temperature began to come down, and within a week it was normal. The patient was then gradually weaned from the respirator and the nasogastric tube was removed as soon as he showed evidence of being able to swallow fairly well. The tracheotomy tube was removed approximately one month later and the tracheotomy was allowed to close spontaneously. The patient then gradually became ambulatory and was started on intensive physiotherapy.

CASE III. A. F. (Admission No. 11,796), a fifty-three year old white man, entered the hospital on November 20, 1951, with the chief complaint of hoarseness, dyspnea and difficulty in swallowing. He had generalized arteriosclerosis and hemiplegia. A diagnosis of massive carcinoma of the right vocal cord was established. The lesion extended to the lateral pharyngeal wall and up to the tonsil involving the upper esophagus. Because of the patient's progressive dyspnea, cyanosis and dysphagia, tracheotomy was performed and a nasogastric tube inserted for feeding purposes. Following the tracheotomy it was noted that fluid taken by mouth appeared at the tracheotomy tube in quantity, indicating overflow of secretions into the trachea because of involvement of the upper esophagus by carcinoma. After insertion of a cuffed tracheotomy tube the patient was no longer troubled by the overflow and the trachea remained dry. The cuffed tracheotomy tube was changed daily. On one occasion a new cuffed tube was not available and an ordinary tube was inserted. The patient remained comfortable for only three hours and then began to fill his trachea with aspirated secretions; another cuffed tube was then made available and the patient had no further difficulty.

CONCLUSION

In this small series of cases the results of utilizing the Guedel-Water endotracheal cuff on a tracheotomy tube were so gratifying that the method is being adopted at this institution as a routine procedure.

SUMMARY

Three cases are presented which illustrate a mode of therapy for preventing pharyngeal drainage from getting into the trachea following tracheotomy. No special equipment or devices are required as all items are standard and found in any operating room.

To our knowledge this is the first reported use of the Guedel-Waters endotracheal cuffs on tracheotomy tubes to prevent accumulation and aspiration of secretions in the tracheobronchial tree.

THE USE OF WIRE IN TENOPLASTY AND TENORRHAPHY*

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IN recent years metallic appliances have been adopted for use in all branches of surgery. Metallic alloys have been so standardized that it has been possible to classify various groups that are completely unreactive to tissue fluids. Devices have been employed for the replacement of normal parts in skull and bone defects, for internal fixation of fractures, permanent sutures, arterial anastomosis, replacement of diseased bone and a host of other purposes.

In these various roles metallic appliances have been used principally (1) as prosthetic devices to replace defects or diseased parts permanently or (2) as interval devices to maintain the alignment of fractures or the apposition of arterial ends or wound edges until normal healing has occurred. This investigation introduces a metallic appliance to serve as a prosthetic device in bridging tendon defects in tenorrhaphy, which may have the further value in serving as a permanent prosthesis in tenoplasty procedures where tendon regeneration is not anticipated.

Tendon defects frequently have been bridged successfully with free tendon grafts. Because of the strong tendency for reactive scarring and binding down of the graft, somewhat better results have been obtained when artificial tendon sheaths have been fashioned by the use of celloidin or metal tubes prior to tendon transplantation. However, limitations still exist in the size of the defect that can be bridged, the difficulty in inserting the graft directly into bone and the problem of revascularization and viability of the graft.

The present investigation reviews our experiences with braided tantalum wire as a tendon prosthesis. Fine strands were carefully braided into a moderately pliable structure (Fig. 1) to give it greater resistance to fatigue. Physiologically the braid permits the ingrowth of connective tissue and tendon tissue into its interstices, allowing firm anchorage of the metal to the tendon.

METHODS

The long tendons of the upper and lower extremities in three large dogs and several large rabbits were isolated and tested in various ways. (1) A section of braided wire was imbedded into the tendon by threading it in and out of the intact tendon. (2) Sections of tendon were excised, creating defects measuring from 1.0 to 3.0 cm. in length, and braided wire was used to bridge the gap by suturing it with cotton into each tendon end. (3) One end of the braided wire was sutured into a proximal tendon stump; the other end of the wire was passed subcutaneously for variable distances from 1.0 to 5.0 cm., on occasion permitting the end to protrude through the skin. (4) Holes were drilled in spinous processes, iliac crests, humeri and ulnas of rabbits. Braided wire was passed through the holes and tied to itself, serving as a retentive device between two bony areas, often with a free end of wire lying along a subcutaneous channel.

Sterile technic was employed. The animals were sacrificed after three months.

RESULTS

In no instance was there infection in the operative area. All wires were firmly bound into the tendon ends by dense connective tissue which had grown into the interstices of the braid. (Fig. 1.) The free expanses of wire that bridged tendon defects were always surrounded by loose connective tissue which attached itself to the surface of the braid and apparently partly grew into the interstices. The latter type of tissue differed from the dense bond at the tendon-wire junction. It resembled normal subcutaneous connective tissue and permitted a fair excursion of the wire. It was estimated that the excursion permitted by the loose connective tissue attachment to the wire was not remarkably different from the normal excursion of the tendon itself.

Only two wires remained exiting through the skin. In all the other instances the dogs had

* From the Orthopedic Surgery Department, Mount Sinai Hospital, New York, N. Y.

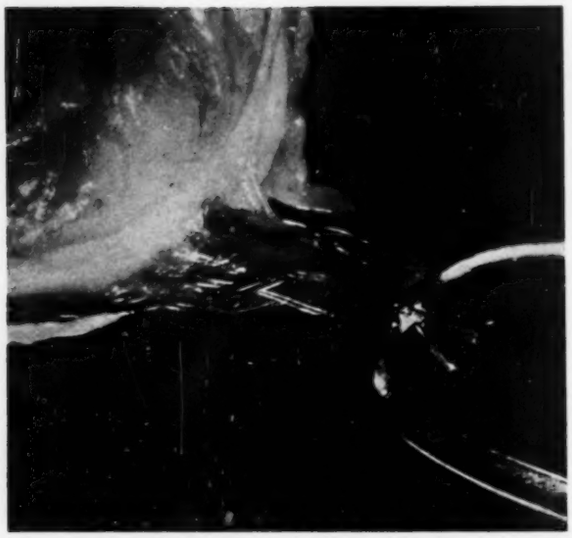

FIG. 1. Tantalum wire mesh in the tendon of a dog for three months. Loose connective tissue has grown into the interstices of the mesh, permitting a firm attachment to the tendon.

FIG. 2. Specimen shown in Figure 1 with weight attached to demonstrate the strength of attachment of wire mesh in the tendon. Sustaining weights of 5 to 10 pounds usually failed to disrupt the attachment, the strength of which roughly paralleled the length of wire imbedded in the tendon.

succeeded in pulling them out. In these two instances at the site of emergence from the skin a small follicle of dense connective tissue had formed. The edges of epidermis covering the follicle were not attached to the wire. The wire itself had become fixed to the subcutaneous tissues and deeper dermal tissues which had grown into the interstices. A small excursion (1.0 cm.) of the wire was noted, allowed by the elasticity of the skin and the mobility of the subcutaneous tissue. The dermal attachment moved with the wire; the wire did not move in and out of a sinus channel. There was no evidence of infection at the site of exit through the skin. The wire was extremely firmly attached to the deeper layers of the skin and could not be withdrawn; as the wire was withdrawn through the skin it pulled the surrounding tissues with it, the skin and the subcutaneous tissues turning inside out like a stocking.

Although the connective tissue binding the wire to the tendon by interstitial growth did not have the appearance of being as dense as normal tendon tissue, the hold afforded the wire to the tendon was surprisingly firm. The pull required to dislodge the wire from the tendon end depended upon the length imbedded within the tendon. Specimens supported 5 to 10 pound weights for sustained periods without any sign of disruption of the union. (Fig. 2.)

Bone did not grow into the braided wire. Wire that passed through the holes made in bone could be moved through a small excursion in its channel (about 0.2 cm.). Loose connective tissue had grown into the braid, firmly binding the wire to the bony channel. (Fig. 3.) When the wire was pulled out of the channel with force, bits of the connective tissue adhered both to the wire and to the bone (Fig. 4), indicating that the wire had been well fixed to the bone, and for practical purposes did not move significantly in and out of its channel. Microscopically there was no evidence of bone erosion or osteoclastic reaction. In fact, there appeared to be early sclerotic reaction along the borders of the channel. In general the wire that had been passed through bone and tied to itself had a firm purchase in the bone and could not be pulled free without fracturing the bone itself.

SUMMARY AND CONCLUSIONS

Braided tantalum wire* was employed as a prosthesis to bridge tendon gaps, to prolong

* Supplied by Ethicon Suture Laboratories, Inc. Division of Johnson and Johnson, New Brunswick, N. J.

FIG. 3. Tantalum mesh wire in the ulna of a rabbit for three months. The wire is bound to the bony channel by loose connective tissue (A).

FIG. 4. Magnification (× 25) of channel in Figure 3 after removal of the tantalum mesh wire by pulling it out forcefully. Note that some of the connective tissue binding the wire to the bone (A) remains attached to the osseous channel.

divided tendons and to gain a purchase into bone in dogs and rabbits.

In general the wire remained inert in the tendon, subcutaneous tissues and bone. Connective tissue easily grew into the interstices of the braid permitting firm fixation of the wire to the tendons. In the subcutaneous tissues, loose areolar connective tissue attached itself to the wire but did not materially diminish its excursion when compared to the excursion of the tendon in its normal function. Bone did not grow into the interstices of the wire as it passed through bony canals. However, the wire did become well fixed to the bone by connective tissue. In two instances in which wire was permitted to protrude through the skin there was no evidence of infection. The excursion noted as it passed through the skin was that which was permitted by the elasticity of the skin and mobility of the subcutaneous tissues.

Further investigation is indicated to determine whether braided wire can be used for tendon prolongations in the human, particularly in reference to its possible application to prosthetic devices.

RECEPTACLE FOR THE COLLECTION OF BILE FOLLOWING OPERATIVE PROCEDURES ON THE BILIARY TRACT*

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SINCE early ambulation has been universally practiced, conventional methods for collection of bile following operations on the biliary tree have been far from satisfactory. Recent procedures,[2] in which such drainage tubes must be left in place over a period of months, pose a serious problem. The employment of the familiar bedside bottle is obviously cumbersome and completely impractical when patients are out of bed shortly after operation. The Erlenmeyer flask is untidy, leaks upon motion, is very uncomfortable and tends to restrict the patient's activity. Baby hot water bottles and other rubber containers[1] are prone to leak when compressed by the patient or his dressings. These flasks must be removed in order to be emptied, thus disturbing the patient and imposing extra work on medical personnel.

The essayists believe that the requirements for such a bile-containing receptacle are as follows: (1) It must be leak-proof, light in weight and sturdy, (2) easy to apply or remove, (3) vented to prevent "air lock," (4) non-compressible so that it can hold an adequate amount of bile, (5) comfortable to wear and non-spillable in most positions the patient may desire to be in, and (6) may be drained without removing container or disturbing the patient.

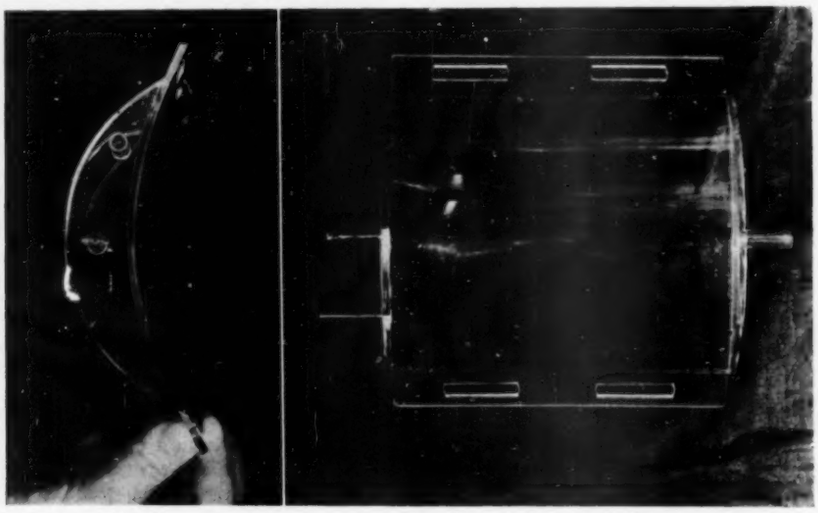

FIG. 1. End view showing curvature of flask, and flat view showing the three tubes and four slots for holding adhesive.

To fulfill the aforementioned criteria we have designed and successfully employed the container now described. The original idea dates back to the prohibition days when "hip-pocket flasks" were made to conform to the curvature of the body. The authors believed these features could well be incorporated into this problem. At first we obtained an old "hip-pocket flask" and remodeled it as described herein. This container was used on several patients with such excellent results that with a few minor improvements its value was greatly enhanced.

This container in the present form is made of rigid plastic material which is transparent, light in weight and strong. It is fastened to the patient and/or dressings by means of adhesive strips which fasten into slots built into the edges of the plastic container. (Fig. 1.)

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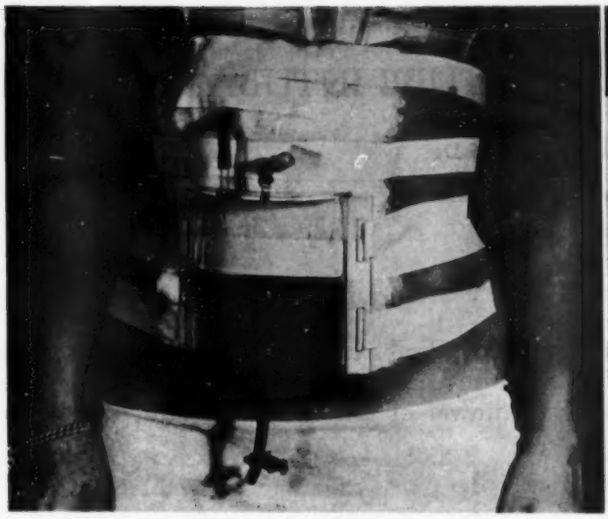

FIG. 2. Patient in an erect position with the container partially filled.

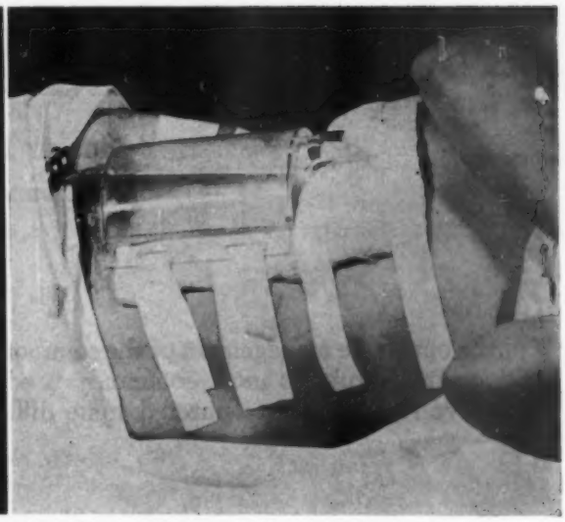

FIG. 3. Shows patient resting on left side.

Three tubes are incorporated into the body of the receptacle. The bottom one is for drainage which is accomplished by placing a length of rubber tubing 1½ inches long over this spout and clamping it off with a screw clamp. (Fig. 2.) There are two tubes on top; the right-hand one connects with the abdominal tube from the biliary tract while the other is partially shut off so that it acts as a small vent which prevents "air locking" and avoids back pressure on the fluid. To insure non-spillage we fasten a finger cot over this vent by means of a rubber band and with a good-sized needle prick a hole through it near the plastic tube. It is readily appreciated that when the bile is withdrawn a vacuum is created, thus shutting off the valve made by the finger cot. In order to obviate this difficulty the rubber cot may be held up so the vent is open it may be temporarily removed when the fluid is withdrawn.

We have found that the arrangement permits from two to six hours' accumulation without having to be drained. It holds about 8 ounces. Since it is transparent, these observations are easily determined and the bottle is not overfilled. The receptacle is not too large and bulky, conforming nicely to the patient's abdomen, neither pressing against the rib cage nor interfering with the lower extremities in a sitting position. As shown in Figure 3, the patient may not only sleep on his back but also has the freedom of lying on his left side without any discomfort.

We believe that the criteria enumerated herein have been fulfilled from a practical standpoint. The container is readily made up from only four curved, rigid, plastic parts and three plastic tubes. It has been favorably commented upon by patients and in our hands has proven most useful as well as inexpensive.

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A NEW COMMON DUCT T-TUBE INTUBATOR

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IN the operative management of the common duct the T-tube is most commonly used. I have frequently encountered some difficulty, as others have, inserting the T-tube into the common duct because the limbs of the T will not find their way easily into the proximal and distal portions of the duct no matter how the tube is manipulated.

To facilitate introduction of the T-tube into the duct I have devised the instrument shown in Figure 1.* It is a simple device consisting of a long rod with a V-shaped spring at the end, the ends of the spring being fitted with small bulbous tips. The rod is longer than the long limb of the T-tube.

In practice it is used as follows: The rubber of the T-tube opposite the junction of the long and short limbs is cut to make sure that there is no obstructing diaphragm and to ease the withdrawal of the tube at a later date. The rod is threaded through the long limb of the tube pulling the springed ends into this long limb. Then the limbs of the T are approximated and the springed ends pushed into these limbs. These limbs are held together and placed over the opening in the common duct as the assistant holds the guide sutures. The limbs are placed into the duct; and as they are released, they will automatically assume their correct positions proximally and distally. The end of the long limb of the T is grasped securely at its junction with the horizontal portion and the instrument withdrawn.

FIG. 1.

* Manufactured by J. Sklar and Co., Long Island City, N. Y.

Case Reports

CONVERSION OF RECTAL COLON INTO FUNCTIONING URINARY BLADDER*

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New York, New York

IN the radical excision of advanced abdominal and pelvic cancer for palliative purposes the surgeon is frequently called upon to improvise procedures that are not anticipated before the abdomen is entered. These improvisations are facilitated by a knowledge of what can or cannot be done, and by weighing the pros and cons before undertaking an operation that entails the creation of an ostomy of one type or another as part of the palliative procedure.

The purpose of this article is to describe the feasibility of converting the lower pelvic colon into a functioning urinary bladder with sphincter control, a situation that was not anticipated before the operation.

CASE REPORT

M. R., a fifty-one year old woman, five days before admission was subjected to exploratory laparotomy in another institution because of a large pelvic and lower abdominal mass. A large carcinoma arising in the sigmoid was encountered and the colon inadvertently entered. This opening was repaired and the operation terminated. Following this the temperature rose to 101° and 102°F., a fecal fistula developed and signs of peritonitis appeared. With vigorous chemotherapy and conservative management signs and symptoms of peritonitis subsided but the fecal fistula persisted.

On admission to the author's private service in the Memorial Center the recent laparotomy wound was found to be intact but in its center a large fecal fistula was noted about which the skin was red and edematous. The patient appeared somewhat cachectic. The lower abdominal and pelvic mass, about 15 cm. in diameter, was noted. The temperature was 101°F. Continuous hot moist dressings were applied to the lower abdomen. After a few days the patient was discharged, conservative management to be continued at home. Ten days later she was readmitted to the hospital for operation.

On March 18, 1952, under general anesthesia with the patient in Trendelenburg position, the old lower midline scar including the fistula and a strip of abdominal wall 4 cm. in diameter was excised. A large irregular soft tumor was revealed, about 15 to 20 cm. in diameter, obviously a carcinoma arising in the lower sigmoid and extending forward to invade the dome of the urinary bladder. A loop of ileum was entrapped in the mass, as was the lower omentum. There were metastatic deposits on the pelvic peritoneum but none in the upper abdomen or in the liver. (Fig. 1A.)

Envisaging palliation only, the entire urinary bladder, 19 cm. of segment of sigmoid colon, uterus, adnexas, lower omentum, pelvic peritoneum, pelvic lymph nodes, and a 21 cm. segment of ileum were resected. In order to do this, of course, the ureters were transected rather low in the pelvis. (Fig. 1B.)

The situation at the close of the excisional phase of the operation was as follows: divided ileum in its mid-portion, empty pelvis except for lower portion of rectal colon about 10 cm. in length and free from gross evidence of disease; transected upper sigmoid; transected ureters.

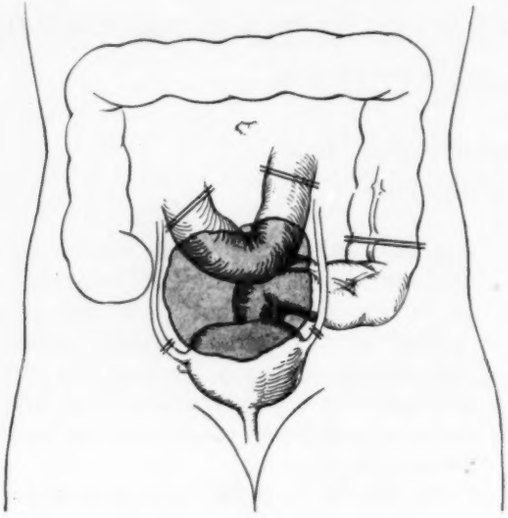
The continuity of the small bowel was re-established by end-to-end anastomosis; appendectomy was performed. One method of

* From the Memorial Center for Cancer and Allied Diseases, New York, N. Y.

procedure would have been to implant ureters into the sigmoid and below this perform an end-to-end anastomosis of the pelvic colon to sigmoid. This was ruled out because of the danger of leakage at the bowel anastomosis site due to constant washing by urine from above.

carried out. The upper transected sigmoid was brought through the abdominal wall as an end colostomy. (Fig. 1C.)

The histologic study showed the neoplasm to be an adenocarcinoma primary in the sigmoid colon. There was infiltration through the



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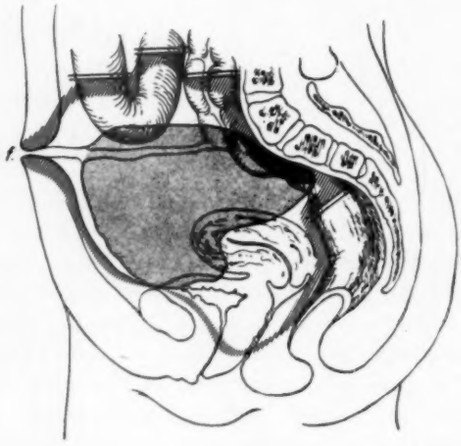

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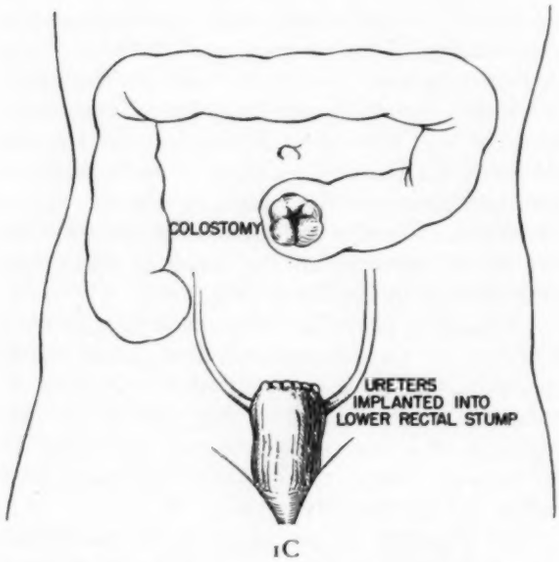

1C

FIG. 1. A, anterior view of large carcinoma of sigmoid extending upward to entrap segment of ileum and downward to invade dome of urinary bladder; the ureters are uninvolved; parallel lines indicate levels of transection of sigmoid above the growth, on the ileum to free the involved portion, and low on the ureters to permit excision of bladder. B, lateral view; shaded line indicates extent of resection to encompass involved segment of sigmoid, loop of ileum, anterior abdominal wall to include f., fecal fistula, uterus and involved urinary bladder. C, the sigmoid has been brought into midline abdominal wound as an end colostomy; the uninvolved lower portion of rectal colon has been closed and both ureters implanted into it converting it into a "urinary bladder."

Another procedure would have consisted of a wet colostomy: ureters into sigmoid and sigmoid brought out through the midline wound; the lower rectal colon could then have been excised or its upper end closed and left *in situ*. The third method was to implant the ureters into the closed segment of lower rectal colon thus converting this into a urinary bladder with anal colon and sphincter mechanism functioning as a urethra. This procedure was entire bladder wall and into the muscularis of the small bowel.

Convalescence was essentially uneventful. The patient rapidly learned to irrigate her colostomy, controlling movements to once every twenty-four to forty-eight hours. She does not wear a colostomy bag.

She was discharged on the twenty-fifth postoperative day and gradually increased her general activities. During the months follow-

ing operation control of urinary excretion via the anus has been very satisfactory. She discharges urine six to eight times a day, feeling the necessity for this by the filled up segment of pelvic colon. During the day control of the anal sphincter is entirely voluntary. During the night she awakens about midnight, voluntarily evacuates the pelvic colon, returns to sleep and awakens about 8 to 9 A.M., with some wetting of the bed. This has necessitated the use of rubber sheets. She has returned to practically full normal activities, engages in social activities, goes anywhere she pleases on foot, in an automobile, bus and the like. There has been no pain and on only one occasion was there a bout of fever for which sulfa drug therapy was prescribed. Pyelograms taken six months after operation showed slight to moderate dilatation of the ureters; blood urea nitrogen was 19 mg. per cent at this time. (Fig. 2.)

On the occasion of her last visit, October 17, 1952, seven months after operation, a disc-shaped mass about 8 cm. in diameter was palpated in the abdominal wall above the colostomy and to the left. This is undoubtedly a recurrence, the presence of which the patient is entirely unaware. Her appetite is excellent and she has no pain. Rectal examination revealed a tight sphincter mechanism and no evidence of recurrent cancer in the pelvis.

FIG. 2. Pyelogram taken six months after operation (retouched), showing moderate dilatation of ureters after implantation into closed lower portion of rectal colon. Blood urea nitrogen 19 mg. per cent.

SUMMARY

An instance is described in which an extensive resection of a carcinoma of the sigmoid invading urinary bladder and loop of ileum was carried out for palliative purposes, necessitating among other things resection of the urinary bladder. The uninvolved lower segment of pelvic colon was closed from above and the ureters implanted into it. In this manner the lower pelvic colon was converted into a functioning urinary bladder with control of urinary secretion during the day; only in the early morning during sleep is there unconscious loss of urine. The satisfactory control of urination thus obtained has contributed to the palliation received by the patient described.

Addendum: March, 1953, one year after operation, the patient was still alive and urinary control remained as previously described. There was minimal pain but the recurrent carcinoma had grown to considerable size, was suppurating and the patient had become cachectic.

FOCAL DEGENERATION OF THE PATELLAR TENDON*

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DISABILITY originating in the patellar tendon arises most commonly either from partial or complete solution of continuity, or from relative mechanical insufficiency of the tendon. Other causes are relatively unusual, but among them is the apparently not heretofore described condition recently seen in three different patients.

CASE REPORTS

CASE I. G. W., a police officer aged forty, was seen in January, 1947. He stated that five months previously, while playing baseball, he had fallen on his right knee and since that time had difficulty in kneeling down.

Examination disclosed a fusiform prominence of the tissues about 1 inch below the lower pole of the right patella. No definite mass could be outlined in the patellar tendon which was obviously the site of the swelling. There was no limitation or abnormality of motion in the knee. Aspiration of the swelling was fruitless. Lateral views of both knee joints, taken to show the soft tissues, revealed a left patellar tendon $\frac{7}{16}$ inch thick as compared with the right which was $1\frac{1}{16}$ inch at its thinnest part.

In an effort to control pain 1 per cent novocain was injected locally. This was followed by a severe hypersensitivity reaction. The possibility of a patellar tendonitis or of focal degeneration of the tendon was not entertained at that time and operation was advised in the belief that the patient was suffering from a cyst or small tumor of the patellar tendon.

On February 3, 1947, after complete subsidence of the novocain reaction, the patellar tendon was exposed under local anesthesia. The fusiform swelling noted clinically and shown radiographically was easily identified and was found to be in the tendon itself. The retropatellar tissues were examined and found to consist of normal fat without any tumefaction. The fusiform swelling was excised and no tumor or cystic swelling was found. Sections of the removed tissue were reported as showing "poorly cellular connective tissue."

A photomicrograph (Fig. 1), however, revealed "that while the general linear configuration of tendinous connective tissue was maintained, the histologic picture was quite unlike that seen in normal tendon. Numerous longitudinal fissures were seen in all sections and the endothelioid lining of these spaces suggested that thay were either vascular or lymphatic channels and not artefacts. The fiber bundles, contrary to those of normal tendon, were arranged in wavy rather than straight columns. The individual fibers stained less intensely than normal and in all sections were disrupted, granular and somewhat refractile in appearance. The fibrocytic nuclei were less compressed than normal and there was no suggestion of any round cell infiltration. The over-all appearance of the specimen was more like a degenerative than an inflammatory lesion."

Following operation the swelling and tenderness disappeared, although a slight sense of "tightness" in the knee persisted. The patient had no limitation of motion and was able to resume his normal duties by March, 1947. There have been no recurrences of symptoms.

CASE II. B. G., a glazer aged forty-five, was first seen when complaining of pain localized to the patellar tendon. This pain was accentuated on kneeling during the course of his work. Because of his occupation it seemed likely that he was suffering from a foreign body (glass) in the tendon. Apart from exquisitely localized tenderness the examination was completely negative. Roentgenogram showed no evidence of a foreign body. Nevertheless, surgical exploration was deemed justifiable and advised.

On October 20, 1947, under local anesthesia the patellar tendon was exposed, The area of tenderness was localized by the patient and the area was palpated and probed with a fine needle but no foreign body could be discovered. A section of the tendon was removed, the wound was closed and the patient was permitted to leave the hospital.

Microscopic sections were reported as showing "degenerated and abnormally vascularized

* From the Second Orthopaedic Service, Hospital for Joint Diseases, New York, N. Y.

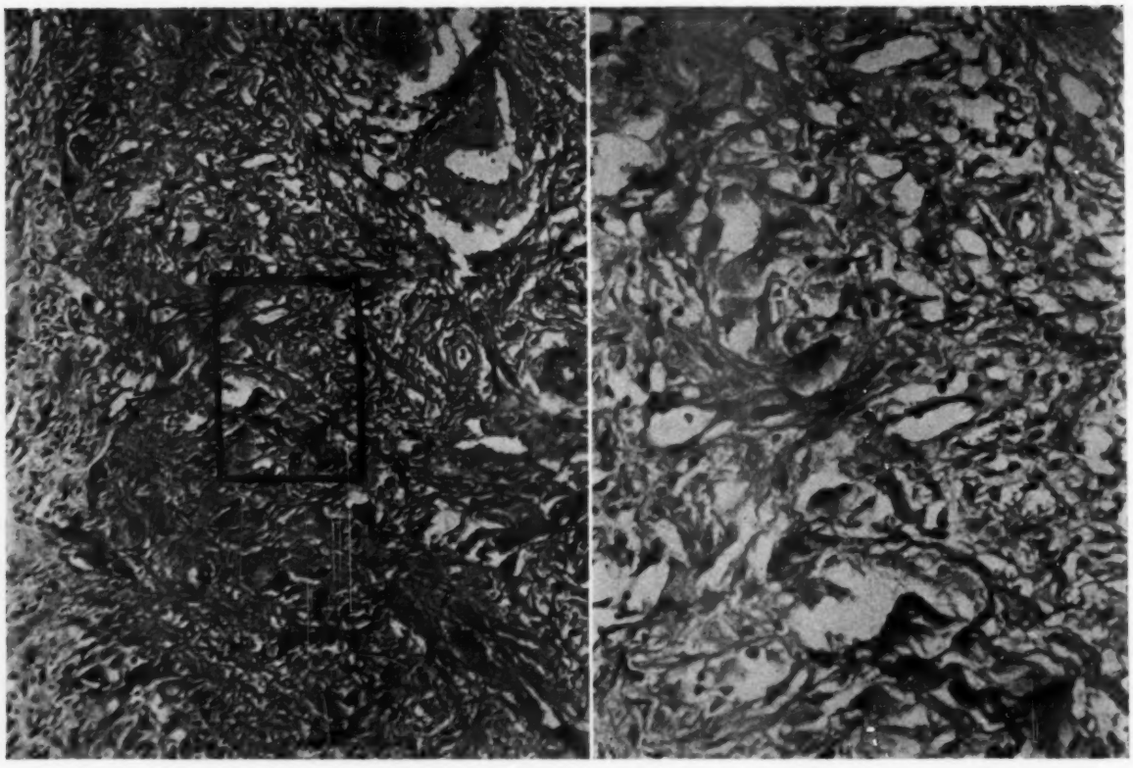
FIG. 1. Case I. Low power photomicrograph revealing "poor cellular connective tissue." Note the fragmentation of the connective tissue bundles and the presence of longitudinal fissures with endothelioid linings.

tendinous tissue." Photomicrographs (Figs. 2 and 3) revealed "a complete loss of normal tendon architecture. The relatively acellular, dense, poorly staining connective tissue bundles interlaced irregularly. Some showed focal areas of hyaline or hyaline-like change. Interspersed between the degenerated tendon bundles numerous dilated blood vessels were seen about which there was new connective tissue. This tissue was quite cellular and was composed mainly of fibroblasts and mononuclear cells. In some areas there were focal collections of lymphocytes. Only occasional polymorphonuclear lymphocytes were seen. There was moderate edema of the tissues."

In general the sections suggested the presence of a degenerative process of tendon with replacement of necrotic tissue by ordinary granulations. It may be that the picture seen histologically in Case II represents a later stage in a single pathologic process, the first stage of which is represented in the sections seen in Case I.

CASE III. D. N., a dancer aged thirty-nine, was seen in September, 1951. He stated that some six months earlier, while performing a step which required sharp extension of the leg with pointing of the toe, he noted pain below the left knee cap. There was no swelling or ecchymosis about the knee and no signs of locking, clicking or giving way of the knee. There was no limitation of motion in the knee and no pain except on extension of the leg. The patient had been given local injections of novocain with temporary relief. Roentgenograms of the area revealed neither bony nor soft tissue abnormality. In August, 1951, while on tour, the pain became so severe that he was forced to seek medical attention.

A physician in Vancouver made a small incision over the tender area of the patellar tendon and is reported to have found "softening of the tendon." Later, the patient noted that the pain was markedly relieved so that he was able to continue with his dancing. His only remaining complaint was pain when walking upstairs and this seemed to be subsiding. Continued conservative therapy was advised and when last heard from the patient had made a complete recovery.



2 3

FIG. 2. Case II. Low power photomicrograph showing "degenerated and abnormally vascularized tissue." Note the complete loss of normal tendon architecture, degeneration of tendinous bundles and presence of numerous dilated blood vessels in areas of apparent granulation tissue. FIG. 3. Same case. High power photomicrograph of area enclosed in square of Figure 2.

COMMENTS AND CONCLUSIONS

All three of these cases showed such a striking similarity in symptomatology and pathologic appearance as to suggest that they constitute a specific entity. The condition appears to be definitely related to trauma or to the trauma elicited by excessive use of the leg. Whether it is in the nature of a minimal tear of some of the fibers of the tendon or is the result of some degenerative phenomenon is difficult to state with finality, although it appears that the latter process is the more probable. This is particularly so since the condition occurred about the age of forty years and is local and well circumscribed. The possibility of minimal tear cannot be entirely abandoned since all of the patients were healthy adults doing relatively heavy work.

The essential element in the symptomatology is localized pain on active extension of the leg, without loss of power of extension. As in the first case reported herein, a nodular swelling may occur but this is not invariable and was not noted in the other two cases.

At exploratory operation very little is seen on gross examination. The patient's assistance in localizing the tender area is of the utmost importance and, accordingly, operation is performed preferably under local anesthesia. In the first case operation was undertaken in the mistaken belief that a cyst or tumor of the tendon was present. In the second case operation was undertaken to search for a foreign body.

It is hardly likely that the surgical removal of a section of tendon for microscopic examination sufficed to cure the condition. It is, therefore, most probable that the condition responds to conservative measures such as rest and heat. Although local injections of novocain may give temporary relief, its use is not always to be recommended. Surgical exploration would seem to be indicated only for the purpose of establishing a diagnosis.

INTRA-ARTICULAR OSTEOCHONDROMA OF THE ASTRAGALUS*

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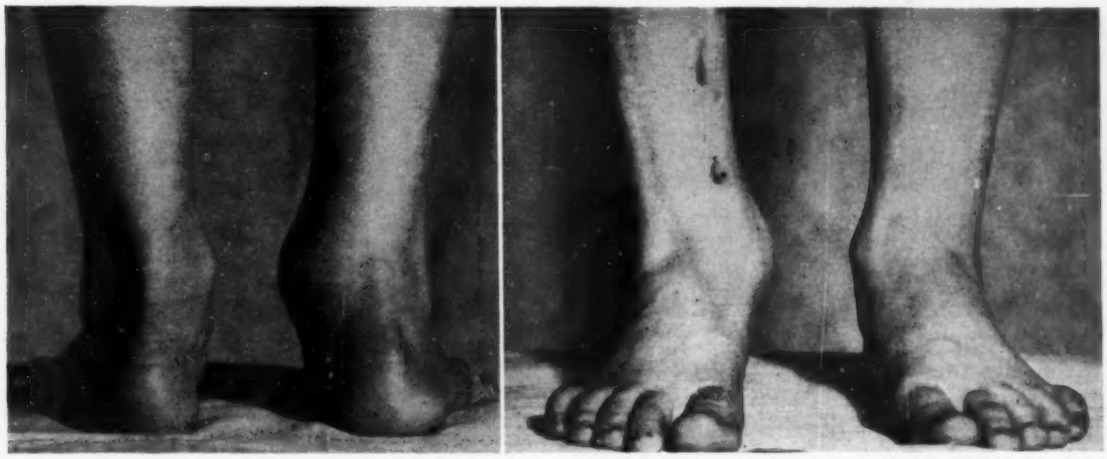
Sayre, Pennsylvania

OSTEOCHONDROMAS as such are not infrequent and have occurred in practically every bony location in the body. Periarticularly, they are related to sites of tendinous attachment and are usually found at the ends of the long bones. Geschickter and Copeland[2] state that the occurrence of proliferating zones in normal tendon ends was first observed by Kolliker in 1853. Their table of benign osteochondromas well illustrates them to be not infrequent and to have many sites of origin. Intra-articularly, they may be found in any joint although the most commonly affected is the knee joint. Opinion varies as to the true etiology and histopathogenesis of this condition. Lewis[3] cites three accepted theories of synovial chondromas, namely, infection, trauma and neoplasm. Primitive connective tissue existing in the synovium of a joint is probably the source of the new growth; however, trauma and infection have been thought to play a part, if only that of an exciting factor.

Rixford[6] in 1930 and Colonna[1] in 1931 presented excellent reviews and case reports of multiple intra-articular osteochondromas or osteochondromatosis.

In 1949 Leydig and O'Dell[4] described two cases of osteochondromatosis affecting the elbow and knee, respectively, which are well illustrative of multiple osteocartilaginous bodies in a joint.



1A 1B

FIG. 1A and B. The clinical appearance of the right lower leg.

The author's case is presented because of its unique intra-articular location arising from the astragalus and resulting in severe deformity of the ankle joint in a ten year old boy. Operative excision was completely successful both in ridding the joint of its pathologic condition and in correcting the deformity.

The duration of symptoms corresponded closely to the average time of four and a half years computed by Meyerding[5] in his study of 232 cases reported from the Mayo clinic.

CASE REPORT

This ten year old boy was seen because of the complaint that his right lower leg was smaller than the left dating from 1946. The patient's ankle had also been larger since that time but the boy had remained on full activities without

* From the Orthopedic Service of the Guthrie Clinic and Robert Packer Hospital, Sayre, Pa.

FIG. 2. Reveals the x-ray finding.

FIG. 3A. Gross findings.

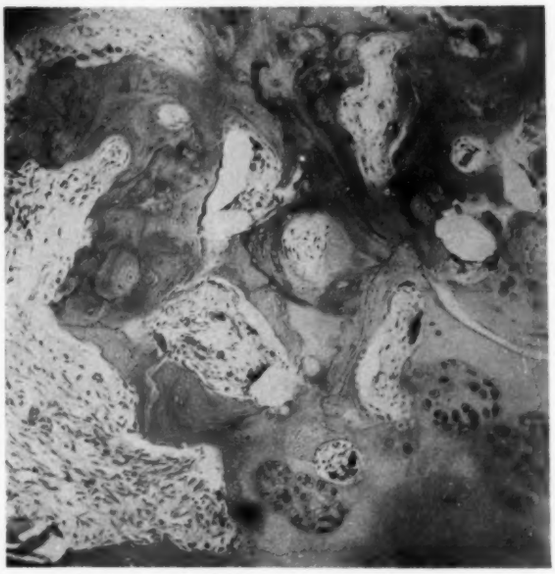


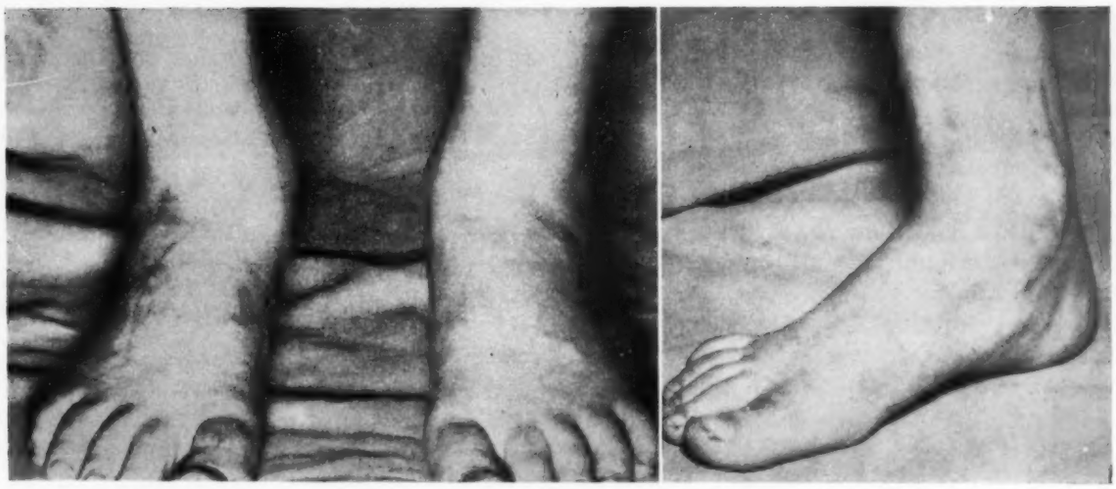
FIG. 3B. Microscopic findings.

complaint. A month before examination the boy complained of pain in the whole right ankle region on walking and running, especially at the end of the day when he became tired.

Examination disclosed that the patient walked with a normal gait with no limp except that he walked with the right foot in valgus and pronation of the heel. There was a large overgrowth just below the right tibial malleolus which was causing a valgus angulation at the ankle mortise. It was not tender and was of bony consistency. There was 1 inch atrophy of the right calf and ½ inch atrophy of the right thigh. Motion of the right foot and ankle revealed that the ankle could be brought up into dorsiflexion to a neutral position only. Plantar flexion, however, was completely normal. The subtalar motion was 50 per cent and the mid-tarsal motion was normal. There was no pain or tenderness on testing the motions of the foot and ankle. X-ray examination of the right ankle and foot disclosed a large bony tumor which was diagnosed radiographically as an osteochondroma involving the right astragalus and producing a valgus deformity of the right ankle mortise. This mass was intra-articular. The remaining examination was completely negative. (Figs. 1A and 2.)

X-ray examination revealed that the tumor appeared to be a typical osteochondroma originating from the medial aspect of the astragalus. This had resulted in a growth disturbance so that the internal malleolus projected inward more than normally. It also caused subluxation in that the body of the astragalus was forced into a valgus position at the ankle joint.

The operative procedure was as follows: A 3½ inch curved incision was made from a point 2 inches above the internal malleolus downward over the malleolus, curving forward over the medial aspect of the foot. The ankle joint was opened medially and the largest portion of the tumor immediately presented itself. It was attached along the medial aspect of the body of the astragalus and was removed by an osteotome. The tumor was roughly wedge-shaped, the widest portion being anteriorly, gradually tapering posteriorly. It was approximately 4 by 2 by 2 cm. along its anterior aspect. After removal of the main



4A 4B

FIG. 4A and B. Final clinical appearance.

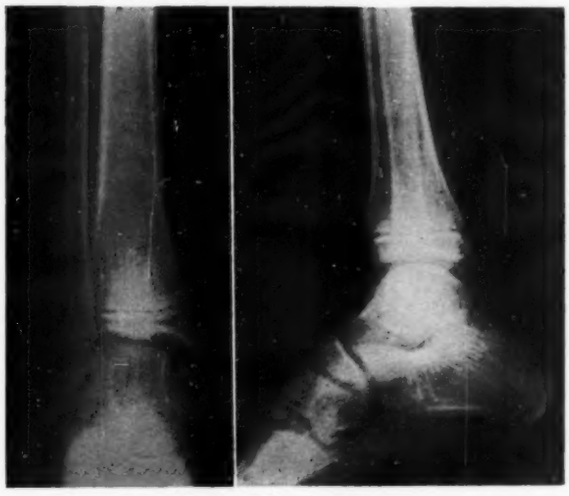


FIG. 5. Final x-rays.

portion of the tumor a cartilaginous loose body, oval in shape and measuring approximately 2 cm. in its longest dimension, presented itself in the posterior aspect of the joint and was removed. This appeared to have been attached formerly to the main tumor mass along a roughened area. The superior and medial aspect of the tumor was covered with an irregular, fissured, pseudoarticular cartilage. The synovial membrane about the tumor was hypertrophic and there was an increase in clear yellow, viscous, synovial fluid. The deltoid ligament was detached from the tumor during the process of excision. The internal malleolus as shown by x-ray was forced outward and upward, and the medial portion of the articular surface of the tibia was forced upward by the presence of the tumor. The articular cartilage covering this portion of the tibia appeared good. The wound was closed in the usual manner and a short leg plaster cast was applied maintaining the foot and ankle in a neutral position.

On gross and microscopic examination the tumor was found to be a typical benign osteochondroma. Grossly, the specimen showed the nodular, smooth, shiny lobulation of cartilage. On microscopic section a typical benign new growth of cartilage and young cancellous bone with fibrous marrow could be seen. (Figs. 3A and B.)

The patient was discharged ten days from the date of admission, wearing a short leg walking cast. The cast was removed at the end of six weeks and he was allowed full weight-bearing without plaster. Examination revealed 20 degrees of plantar flexion and 10 degrees of dorsiflexion. Clinically there was still prominence of the medial malleolus.

X-ray examination revealed an excellent result of the excision of the tumor although a widened ankle mortise and an upward, inward thrust to the medial malleolus remained.

One year following excision the patient was on normal activities without complaint. Examination revealed a normal gait with full range of motion of the ankle and all joints of the foot. Posture revealed the previous valgus was practically completely corrected. The ankle mortise was stable. Slight prominence of the internal malleolus remained as compared to the normal or left side. (Figs. 4A and B, and 5.)

Atrophy (¾ inch) of the right calf remained. The leg length measurement was equal. Clinically, slight prominence of the medial malleolus remained and x-rays revealed some residual widening of the ankle mortise.

SUMMARY

The author has presented a case of benign solitary osteochondroma arising from the astragalus of a ten year old boy, causing disability and deformity of the ankle joint which subsequently disappeared following operative removal.

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A few patients with clinical signs of gallbladder disease have a functioning gallbladder and no stones. Surgery is therefore not indicated. However, a small percentage of these occasionally show, by the evacuation type of oral cholecystogram, that there is dilatation of the common bile duct with stenosis of its terminal segment. In such instances combined supra- and transduodenal exploration will confirm these findings and indicate sectioning of the stenotic area which is due to fibrosis of the sphincter of Oddi. (*Richard A. Leonardo, M.D.*)

POSTERIOR MEDIASTINAL GOITER*

USE OF COMBINED THORACOCERVICAL APPROACH FOR EXCISION

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THE occurrence of posterior mediastinal goiter is infrequent. In previously reported cases various operative approaches were utilized for excision.[1–10] The use of a combined thoracocervical approach for removal of a posterior mediastinal goiter is described herein.

In Crile's[1] series of 11,800 thyroidectomies, there were ninety-seven intrathoracic goiters. In a series of 1,200 cases of goiter reported by Wakeley and Mulvany[2] there were twenty intrathoracic goiters, of which only three were totally intrathoracic. The incidence of posterior mediastinal goiter is still rarer. Only two in a series of 8,500 cases of goiter were reported by Urban.[3] There are scattered reports of cases in the literature, but in aggregate there are fewer than forty.

The usual location of intrathoracic goiter is in the anterior position of the superior mediastinum. An enlarging cervical goiter can easily extend between continuous fascial planes into this substernal position, particularly if the lower poles enlarge.

The mass derives its blood supply from the inferior thyroid artery which descends with it. The recurrent laryngeal nerve lies posteriorly, as do the subclavian and innominate vessels. Diagnosis is usually not difficult. These goiters, with rare exception, can be removed through a cervical approach, as long advocated by Lahey.[5]

In rare instances the intrathoracic goiter lies posteriorly, either in the posterior portion of the superior mediastinum—cephalad to the body of T4 or in the true posterior mediastinum, a division of the inferior mediastinum below the level of T4. Here the mass lies behind the subclavian and innominate vessels and behind the recurrent laryngeal nerve and inferior thyroid vessels.

The reason for posterior location is not clear. Sweet[4] believes that these goiters arise from the posterior aspect of the cervical thyroid rather than from the inferior poles and are thus directed toward the posterior mediastinum.

A theory based on the embryology of the thyroid gland has been described by Crohn and Kobak.[6] The main mass of the thyroid is derived from the ventral floor of the pharynx at the level of the first pharyngeal pouch (Arey). This primordium, forming the isthmus and a portion of each lobe, is then joined by the ultimobranchial bodies, derived from the fifth pharyngeal pouches, giving rise to a major portion of each lobe. Failure of this fusion would leave the ultimobranchial bodies deep within the mediastinum, adjacent to the posterior pericardium—a source of thyroid tissue in the posterior mediastinum.

Posterior mediastinal goiter cannot be as readily distinguished from other mediastinal tumors as can its anterior counterpart. This factor alone has accounted for the utilization of a thoracotomy in approaching the mass. Touroff[7] has recently indicated that the use of radioactive iodine and a Geiger counter will reveal functional thyroid tissue in the mediastinum in practically 100 per cent of cases. This will be an important aid to diagnosis.

Symptoms due to compressive or compression distortion of the trachea and esophagus can be alleviated only by surgical excision of the goiter. In asymptomatic cases surgical removal is indicated as a prophylactic measure, as further growth is the usual course, with production of symptoms at a time when the surgical procedure is made more difficult by the larger size of the mass.

Although the blood supply of a posterior mediastinal goiter usually descends from the inferior thyroid artery, the routine use of a cervical approach is not always feasible. In the posterior mediastinum the mass of thyroid tissue may be intimately adherent to the azygos vein or superior vena cava. Dissection around the mass performed blindly from above would

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certainly have caused serious hemorrhage in the case reported herein. It must also be kept in mind that some of the blood supply may be derived from mediastinal vessels. Another indication for transthoracic visualization is the inability to distinguish definitely the goiter from other types of mediastinal tumors.

However, while we believe that the cervical approach is frequently inadequate, we do not champion a pure thoracic approach in every case. Control of the usual blood supply, descending from the neck, may be difficult from within the chest because the vascular pedicle may be obscured by the overlying subclavian vessels, as in this case. Thoracic exposure can be utilized to identify the mass as a goiter, and to free it from the azygos vein and superior vena cava. Then, through a cervical incision, the blood supply to the mass can be best secured, the mass safely drawn up out of the mediastinum and any associated cervical goiter can be removed.

CASE REPORT

M. Y., a sixty-five year old white woman, was admitted to the Gynecology Service on January 10, 1951, for investigation of postmenopausal vaginal bleeding. The patient had had two episodes of painless bleeding in the past four months. For several years she had known of an enlargement in the left side of her neck diagnosed as being in the thyroid, but with no recent change in size.

Positive findings on physical examination, apart from the surgical condition, were obesity, palpable enlargement of the left lobe of the thyroid and a cystocele and rectocele. The left lobe and pyramidal lobe of the thyroid gland were prominent and easily palpable, estimated as two to three times normal size. The right lobe was also palpable but it did not present anteriorly.

Laboratory findings were as follows: hemoglobin 15.7 gm.; white blood count, 9,050; Mazzini test, negative; urinalysis, unremarkable; fasting blood sugars, 187, 172 mg. per 100 cc.; blood urea nitrogen, 16.7 mg. per 100 cc. No radioactive iodine studies were carried out.

X-ray examination of the lumbosacral spine and pelvis revealed hypertrophic osteoarthritic changes. X-rays of the chest showed a soft tissue density in the right upper posterior mediastinum. The trachea was displaced anteriorly. With the esophagus outlined by barium, there was deviation to the left at the level of the mass. Fluoroscopy revealed no pulsation of the mass. (Figs. 1 to 3.)

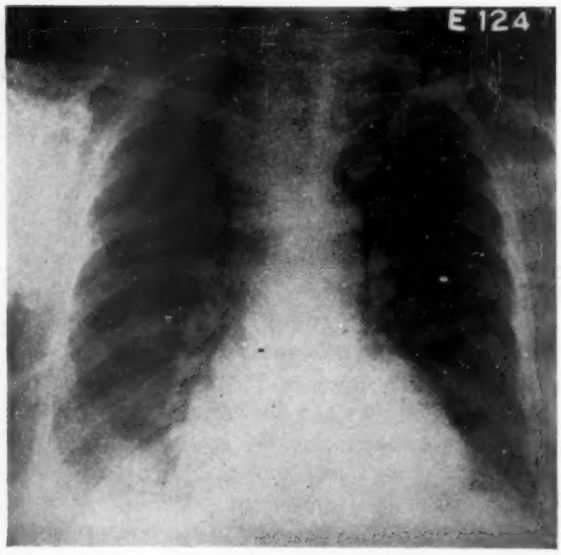
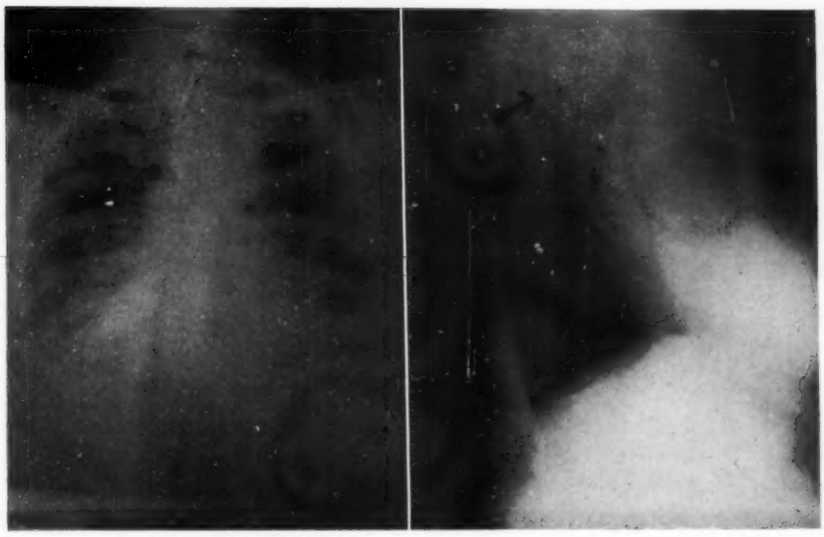


FIG. 1. Postero-anterior roentgenogram of chest revealing mass in right superior mediastinum.

Dilatation and curettage of the uterus revealed endometrial hyperplasia and chronic cystic cervicitis. The patient was then transferred to the surgical service for investigation of the mediastinal mass. Although there were no associated symptoms, surgical exploration of the chest was advised because of the x-ray evidence of distortion of the trachea and esophagus which was believed would increase as the mass enlarged. Because of the possibility that this might be a tumor arising in the thorax, it was approached through the chest.

At operation a parascapular incision was made and the chest entered through the bed of the fifth rib, after subperiosteal resection of the fifth and a portion of the fourth ribs. A pear-shaped mass was found extending from the neck behind the subclavian vessels into the posterior portion of the superior mediastinum, with the main bulk of the mass lying to the right of the superior vena cava and with its base closely adherent to the azygos vein. It was covered by the parietal pleura and its surface traversed by several small veins. The mass had the appearance of thyroid tissue.

The tumor was freed from the azygos vein and other mediastinal structures by blunt and sharp dissection. It became apparent that the principal blood supply to the mass descended



2 3

FIG. 2. Anteroposterior roentgenogram of chest. Displacement of esophagus to left demonstrated by barium swallow.

FIG. 3. Right lateral view of chest; trachea is displaced anteriorly.

from the neck. Because it was not possible to transect the tongue of tissue safely as it descended lest the subclavian vessels be injured, the chest wall was closed in the conventional manner. The patient was then placed in supine position and a cervical collar incision was made. The ribbon muscles were divided to facilitate exposure of the thyroid gland. The left lobe was three times enlarged and nodular in consistency. The pyramidal lobe was enlarged to twice the normal size and the right lobe projected posteriorly and inferiorly, its lower pole being the previously exposed mediastinal tumor. The upper pole was wrapped around the trachea, with considerable tissue in the retrotracheal plane. The superior thyroid vessels were secured by suture ligatures, as was the group of middle thyroid veins. The inferior thyroid vessels were tied in continuity. In drawing up the mediastinal prolongation of the goiter, the dome of the pleura was opened. This was later closed by interrupted sutures. We believed that the operation would be unnecessarily prolonged by resection of the pyramidal lobe and a portion of the left lobe of the thyroid, so closure of the cervical wound was accomplished to the emergence of a Penrose drain, which extended to the dome of the pleura. Silk technic was used throughout.

Pathologic examination revealed the following: grossly, the specimen labeled right lobe of thyroid consisted of an irregular-shaped mass of thyroid tissue measuring 12 cm. in length, 5 cm. in greatest width and 2 cm. in greatest thickness. Its total weight was 55 gm. It was made up of reddish tissue for the most part, with some areas of yellow tissue and a few areas of hemorrhage. Microscopically, sections revealed salient features of so-called fetal adenoma. Central areas were degenerated and small hemorrhages were present. The stroma was increased in some areas and a few collections of small lymphocytes were also seen. Diagnosis: nodular goiter; so-called fetal adenoma.

The patient tolerated the procedure well and made an uneventful recovery. Her would healed *per primam*. Postoperative x-rays revealed full expansion of the lung. She was fully ambulatory within forty-eight hours and was discharged on the eighth postoperative day. The patient has remained well.

SUMMARY

1. Posterior mediastinal goiter is discussed and one case is described.

2. Cervical excision of all intrathoracic goiters is not always feasible.

3. The use of a combined thoracocervical approach is described and its advantages considered.

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Patients with peptic ulcer suffering a severe, acute, upper gastrointestinal hemorrhage may first be tried on conservative therapy, especially if they are under fifty years of age. In elderly and arteriosclerotic patients prompt surgery is usually indicated because in an ulcer on the posterior duodenal wall or in the stomach the partially ruptured and sclerosed artery is not likely to seal itself off. Ulcers on the posterior duodenal wall may erode into the large gastroduodenal artery and, of course, the main arteries of the stomach are all large; hence prompt surgery is needed to prevent death. Even in younger patients if conservative therapy is ineffectual surgery must be performed. Blood transfusions are very helpful; but if they cause the patient to bleed more (by raising his blood pressure), many surgeons discontinue preoperative transfusions until the bleeding has been controlled on the operating table. Usually a subtotal gastrectomy is indicated in these instances. (*Richard A. Leonardo, M.D.*)

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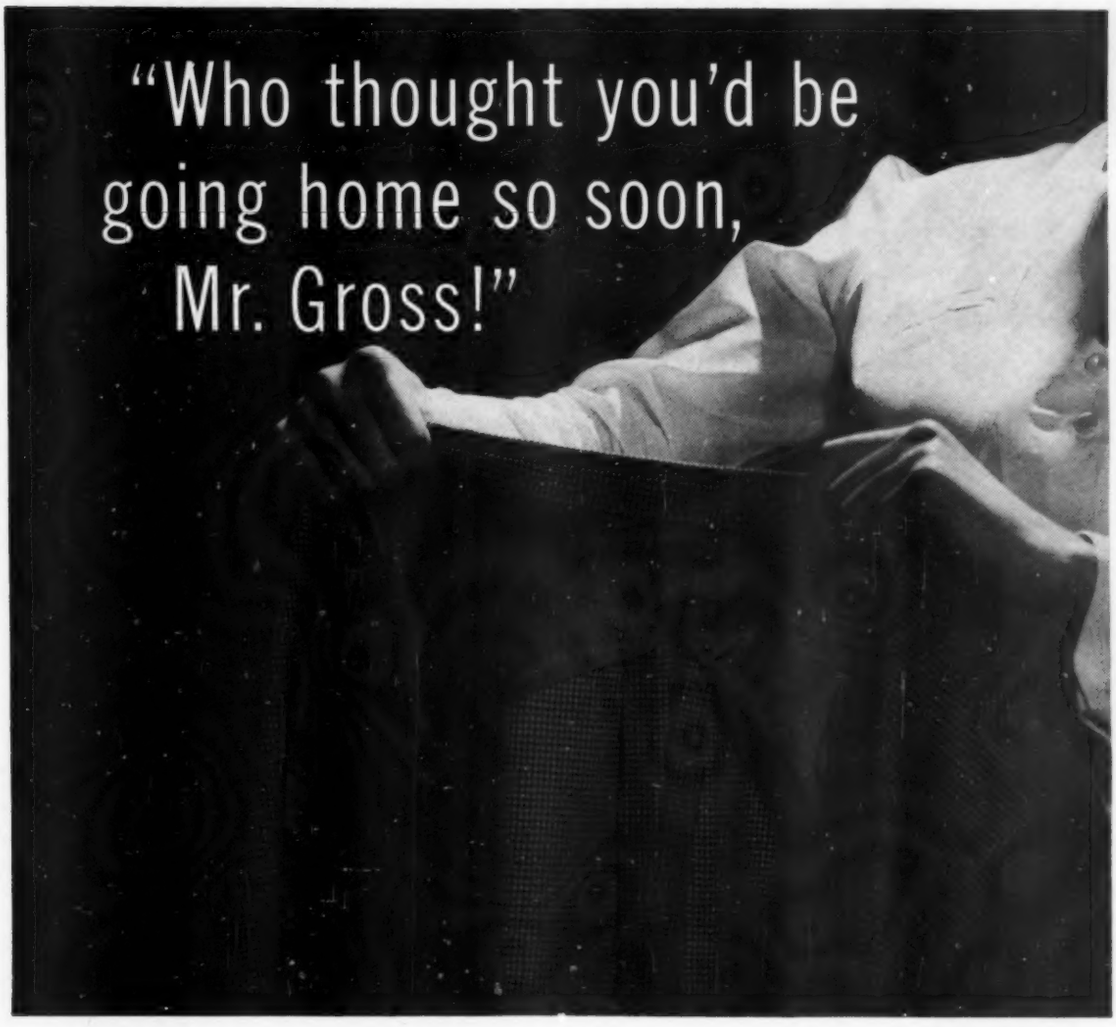

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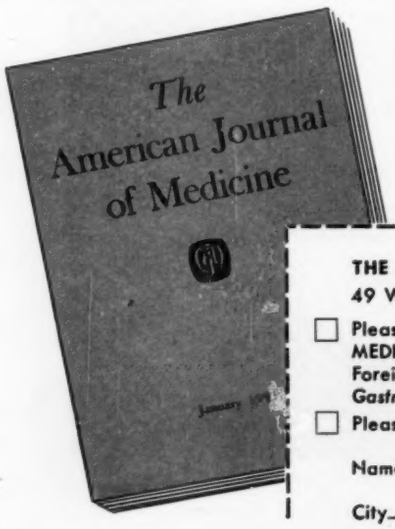

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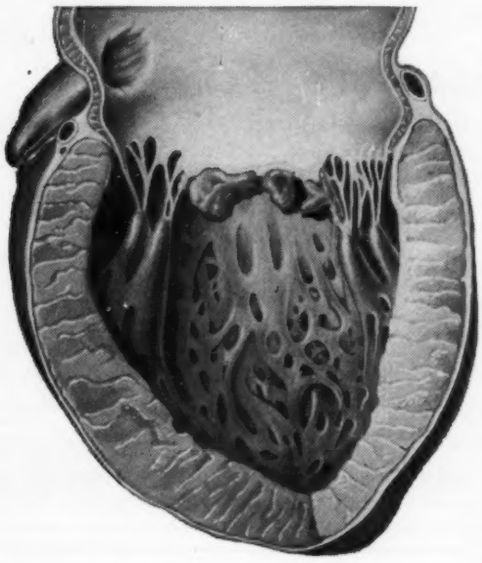

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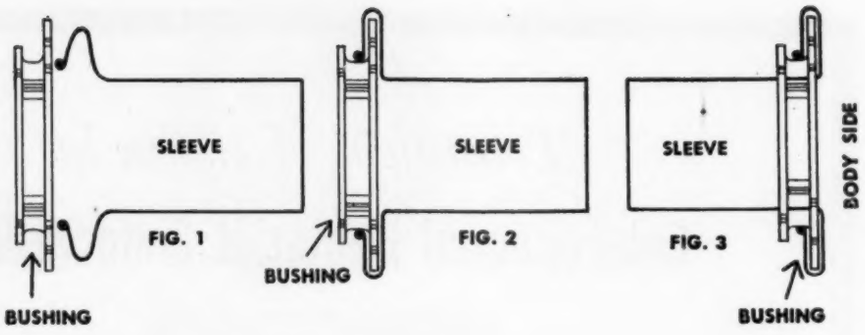

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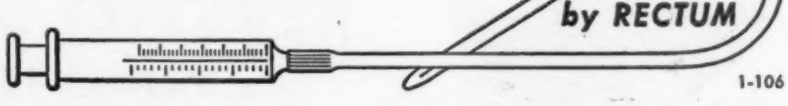

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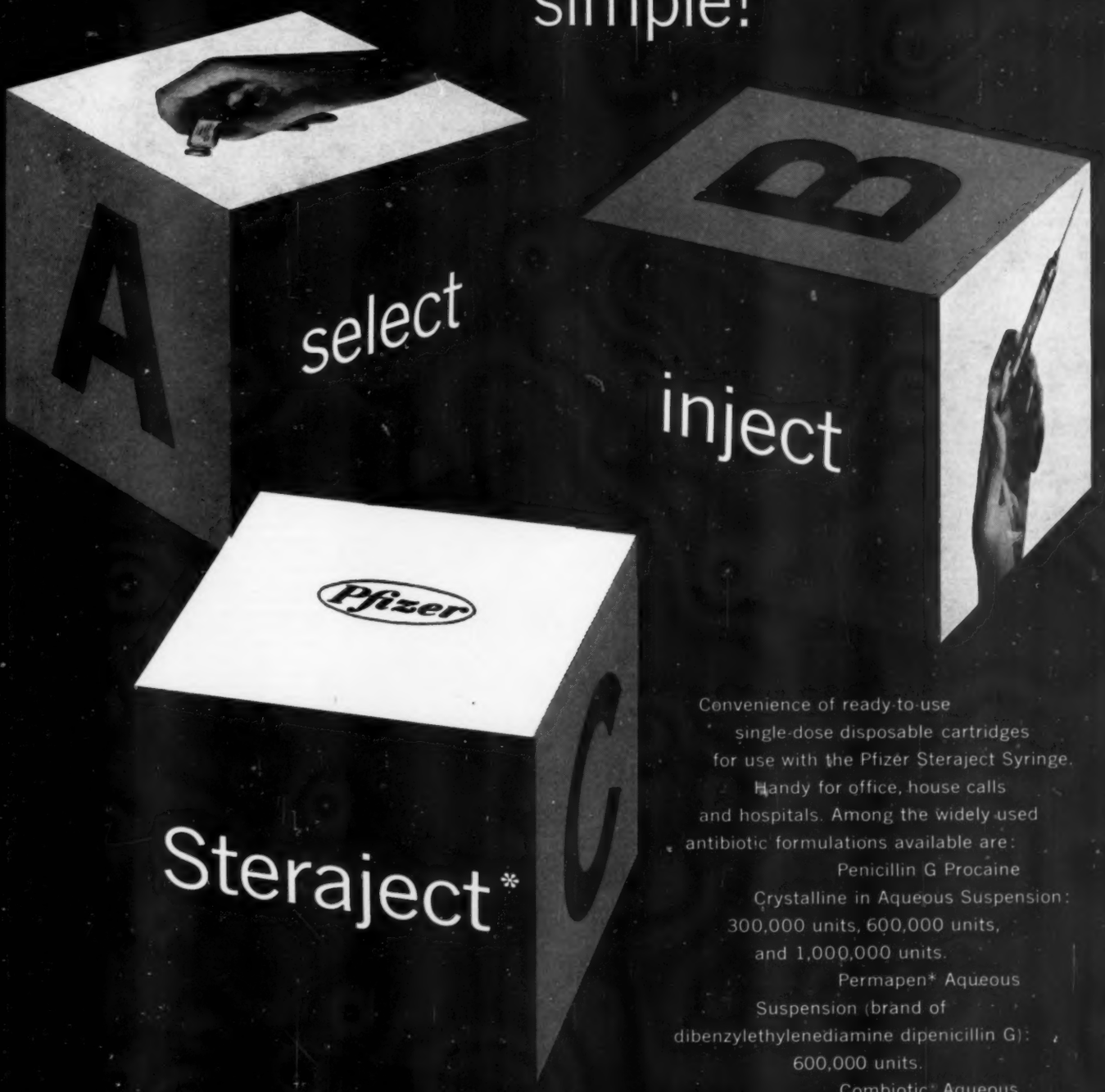

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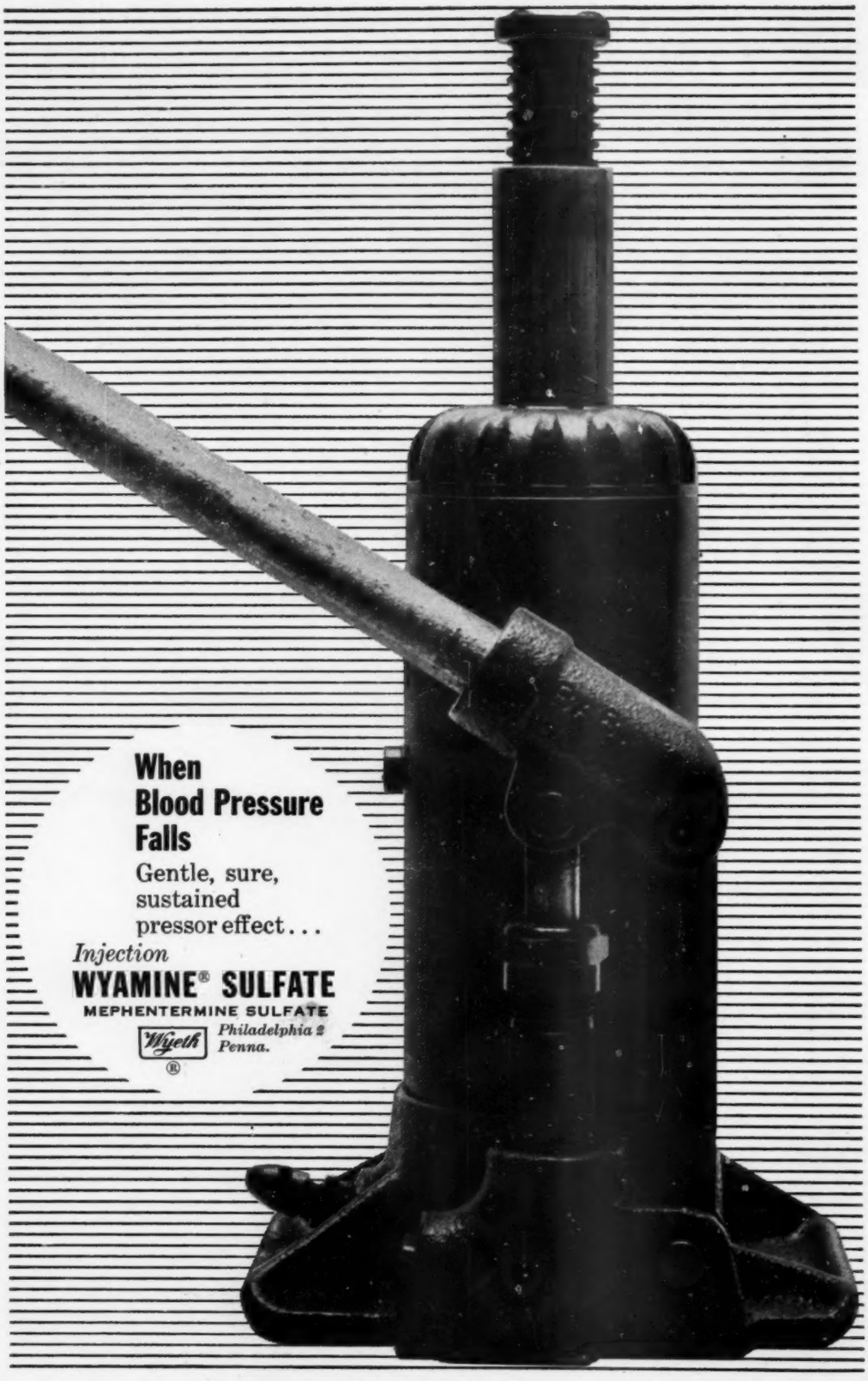
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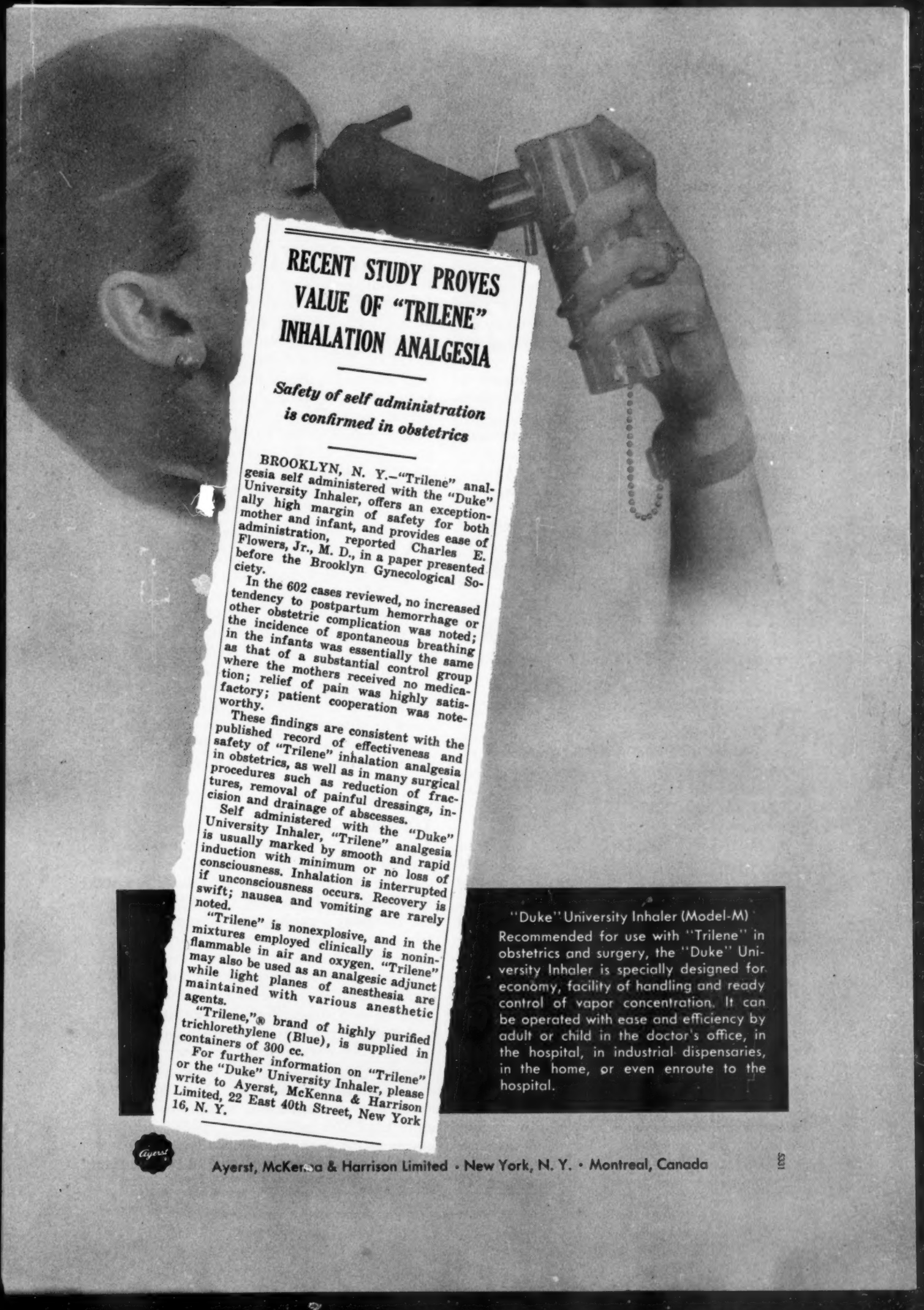

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THE average length of life among American wage earners and their families is sixty-eight and one-half years, according to the 1952 experience among the industrial policyholders of the Metropolitan Life Insurance Company. This is a gain of slightly more than four years since 1942 and of about twenty-two years in the past four decades.

IF it takes you longer than one minute to trim the toenails on one foot, you are probably doing the job improperly. This is what Dr. David I. Schwartz, chief of the orthopedic section of the Veterans Administration Hospital, New York, told a group of physicians at Chicago. He spoke on what he called "the lowly ingrown toenail" before the 20th annual meeting of the American Academy of Orthopedic Surgeons in the Palmer House. He stated that the nail should be trimmed across the distal end so as not to injure the skin. The sharp corners on each end of the distal most portion of the nail can then be rounded off with scissors or emery board, but under no circumstances should the nail be trimmed into the tissue.

RETIREMENT of Benjamin F. Hirsch from his post as executive vice-president and director of Davis & Geck, Inc., was announced. He will remain available to the firm, a manufacturer of surgical sutures and specialties, as a consultant.

AMERICANS pay approximately the same amount each year for health and medical services as they do for alcoholic beverages and tobacco supplies. The stark figures are $13,600,000,000 for health vs. $13,200,000,000 for alcohol and tobacco.

APPLICATIONS for certification (American Board of Obstetrics and Gynecology) for the 1954 (Part I) examinations are now being accepted, and candidates are urged to make such application sometime in August or September. This would be of great help in expediting processing of these applications. Candidates applying for admission to the Part I examinations are reminded that the Board now requires them to submit a list of all patients admitted to the hospitals where they practice for whom they have been *solely* responsible for the year preceding their application or the year prior to their request for reopening of their application, with the diagnosis, pathologic diagnosis, nature of treatment and end result. This list should be submitted at the time application is made or at the time request for reopening of an application is sent, and it should be on 8½" by 11" paper, unbound, and contain the name of the candidate and his address.

Requests for Applications for Appraisal of Incomplete Training, Applications for Certification, current Board Bulletins, and Preceptorship or Supplemental Training Forms should be made to: Robert L. Faulkner, M.D., Secretary, American Board of Obstetrics and Gynecology, 2105 Adelbert Road, Cleveland 6, Ohio.

A PRONOUNCED shift from small families to families of moderate size has been in progress in the United States since 1940. The trend is evidenced by the increasing rate at which third, fourth and fifth children are being born into the family. From 1940 to 1950—the most recent year for which this data is available—the birth rate for third children rose by 77 per cent, for fourth children by 50 per cent and for fifth children by 27 per cent. Fluctuations in the birth rate in the United States since the beginning of World War II, the statisticians observe, probably are without parallel in the country's history.

JOHNSON & JOHNSON has begun a broad new type of program to make available to nursing schools and hospitals the latest types of teaching materials and economy studies, it was announced by E. Wayne Comer, manager of the company's midwestern hospital division. The program seeks to assist the professions in their drive to utilize most effectively the time and skills of available graduate nurses, to expand continuing "in service" training of professional and non-professional hospital personnel on all levels and to cut costs in patient care. It was prepared under the guidance of an advisory council of outstanding nursing educators and hospital administrators. Development followed lines recommended to the company by more than 100 professional leaders and 1,000 nurses in 177 hospitals across the country during a six-month study of current needs and problems.

(continued on page 48)

The Surgeon's Mart

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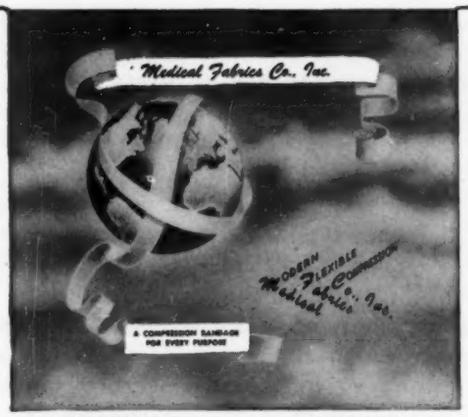

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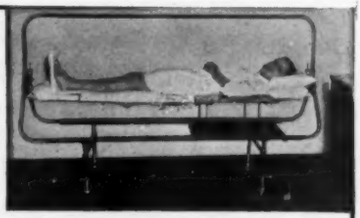

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The Surgical Engineering Company, Inc.

Outside the Ivory Tower

(*continued from page 46*)

"BORN a veritable embryo, the opossum is particularly well adapted to such studies as hormone and drug action, sex development and the development of the nervous system in relation to behavioral responses. Stupid as the opossum is, he makes a valuable contribution to the sum of human knowledge."

Dr. Carl G. Hartman, associate director of the Ortho Research Foundation, Raritan, New Jersey and an authority on the opossum, makes this point in a new book called "Possums," published by the University of Texas Press as the most complete definitive life history yet written on the subject.

DUKE University Nursing School will begin a new two-avenue program this Summer to help meet the nursing shortage in the State. High school graduates now are eligible to enter directly into nurses' training in one of two programs: (1) A revised three-year course leading to the diploma in Nursing; (2) a new four-year program leading to the degree of Bachelor of Science in Nursing. "This program will not only help meet the need for bedside nurses in North Carolina," Dean Florence K. Wilson said, "but also will help fill the demand for head nurses, administrators and supervisors."

Under the new plan, the total Nursing School student body should increase from 130 to more than 300 by 1956, she said. The School will graduate about eighty students each year, more than twice as many as are in the present senior class. This will mean more bedside nurses, as well as more qualified personnel for top positions in nursing. Revision of the three-year program makes it possible for high school graduates to enter directly into training. Duke has previously required one year of college for admission.

THE Veterans Administration Hospital, Lyons, New Jersey, has available residencies in Psychiatry for a one- to three-year period which are fully accredited by the American Board of Psychiatry and Neurology. The training can begin at any time and the program consists of lectures, conferences and seminars under the direction of the Department of Psychiatry, New York Medical College, and offers intensive training, both intramurally and through rotation in special hospitals in the adjacent area. There is, in addition, a series of extensive guest lecturers as well as an Annual Institute at the hospital.

THE E. R. Squibb Company, of New York, announce the availability of a new black and white sound film (16 mm., 25 minutes) in the following write-up:

"We now know that just as the earth gives forth life in the beginning and receives it back at the end, so also does the earth *preserve* life during its course.

"This new documentary film tells about this miracle: it tells about the earth-derived medicines known as the antibiotics, how science seeks them out and how it brings them to the physician that he may conquer disease, lessen suffering and lengthen the span of human life.

"Here, highlighted by the magic of the deRochemont camera, is the engrossing story of the unending quest for powerful new antibiotics in tiny samples of soil gathered from all parts of the globe. In the end, perhaps only one soil sample out of many thousands yields an organism which elaborates an antibiotic with healing powers, but the discovery of one such organism more than makes up for all the failures.

"As important as the isolation of a new antibiotic which emerges the victor against disease is the translation of discovery into production. First, pharmaceutical laboratories produce enough of the new agent to permit extensive pharmacological testing and eventual clinical trial. Then, production engineers are called upon to solve the complex problems necessary to step up production from five gallon lots to as much as a thousand gallons at a time, duplicating on a huge scale the extreme accuracy and scientific caution once associated only with laboratory processes of test-tube size.

"Finally, thousands of precisely measured quantities of the new antibiotic medicine are individually packaged and distributed to physicians in many lands, thus bringing to fulfillment a process of creation that began with the discovery of a single micro-organism in a pinch of soil, and that step by step throughout its course, has called forth the utmost talents of gifted men in both science and industry."

(*continued on page 50*)

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STRYKER BONE SAW

Oscillates at high speed, assuring unusual safety and convenience. Five interchangeable blades cut on forward and backward strokes . . . never catch in drapes or sponges . . . or hurl blood. Blades adjust to three positions. Built to highest standards of quality and performance.

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35-mm. EXAKTA "VX"

Single Lens Reflex Camera for Parallax-Free Surgical Photography

The Exakta, with both regular and telephoto lenses, is widely used in hospitals for operation room photography. Its unique through-the-lens viewing system assures absolutely correct "on the subject" photographs during every step of the operation. In addition, this world famous medical camera is regularly used for preliminary, developmental, and end result pictures of patients; for copying X-Rays; and for making color transparencies of injuries and lesions —a necessity for recording and lecturing.

With f2.8 Zeiss Tessar "T" Coated Lens with Pre-Set Diaphragm Control	$279.80
Penta-Prism Eye Level Reflex Viewfinder	50.00
Extension Tube Set	24.00
Microscope Adapter	29.50

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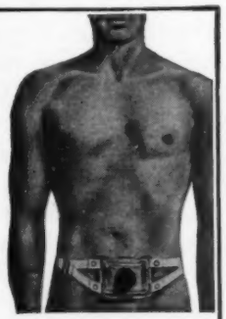

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ETNA Appliance & Equipment Co., Inc., Etna, N. Y.

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- Two-to-one gear ratio for accurate drilling.
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THE ALL-PLASTIC CAST BANDAGE

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Size 3 and 4 drilled to take towel clamps—for use in perineal repair.

Write for Literature and Reprints

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Outside the Ivory Tower

(*continued from page 48*)

THE first issue of a quarterly journal, entitled "Revista Latino Americana de Cirugia Plastica (Latin American Journal of Plastic and Reconstructive Surgery) appeared in April of this year. Subscriptions should be sent to Revista Latino Americana de Cirugia, Tuxpan #23, Mexico, D. F.

VERNON GEORGE VERNIER, M.D., has been appointed to the position of Research Associate, Pharmacodynamics, at Sharp & Dohme, Incorporated, it was announced by Dr. Karl H. Beyer, Director of Pharmacology. Dr. Vernier was formerly an Instructor in Pharmacology at the University of Illinois College of Medicine and will continue his research in neuropharmacology.

THE Best Anemia Classifier provides a simple and rapid means for classifying the anemias—given the red blood count, the hematocrit and the hemoglobin. It is actually a circular slide rule on which the red blood count, hematocrit and hemoglobin are lined up with a rule on the indicator, after which all of the constants are read directly. The Mean Corpuscular Hemoglobin can be read either in micromicrograms or as color index. The Mean Corpuscular Hemoglobin concentration can be read either in percentage, as saturation index, as normochromic or hypochromic. The Mean Corpuscular Volume can be read either in cubic micros, as volume index, as microcytic, normocytic or macrocytic. In all cases the normal ranges for male and female are indicated as are the normal values for the blood constants. Similarly, the range of error for each of the tests is indicated. Where hemoglobin values are given in percentage, they may be aligned with the value on the indicator corresponding to 100 per cent for the hemoglobinometer used which automatically compensates for the various standards.

The Classifier is attractively printed in four colors on heavy gauge plastic. This Classifier will be appreciated equally by the physician and laboratory technician since it automatically calculates the blood constants, eliminating the many calculations which would otherwise be necessary. Literature is available from the Clay-Adams Co., Inc., 141 East, 25th Street, New York 10, N. Y.

THE new "MSA Pulmonary Ventilator," first exhibited at the recent annual meeting of the College of Chest Physicians, is described and illustrated in Bulletin No. 1106-1 just issued by Mine Safety Appliances Company. Designed specifically for therapy of emphysema, silicosis, asthma and other pulmonary disorders, the new instrument is offered for use by hospitals, physicians or, on the physician's prescription, by the adequately trained patient.

The MSA Pulmonary Ventilator employs a newly developed valve which is actuated by the patient's inhalation effort. The valve thereafter delivers a preset positive pressure to the patient's lungs. A specially designed separate exhalation valve allows rapid exhalation to the atmosphere; that is, exhalation does not go back through the positive pressure valve. Easy maintenance and cleansing are said to be among practical features of the new instrument. The entire exhalation mouthpiece can be washed and reassembled within two or three minutes.

Copies of the Bulletin are available to physicians, hospitals, nurses, and industrial dispensary personnel, without obligation, upon request to Mine Safety Appliances Company, Braddock, Thomas & Meade Streets, Pittsburgh 8, Pa.

MOST significant blood development during the last year was the Red Cross decision to meet the Office of Defense Mobilization's request to make gamma globulin available for poliomyelitis sufferers during the summer of 1953.

Gamma globulin—or immune serum globulin—is the blood protein containing the antibodies that the human system manufacturers to protect itself against disease. If a person has ever had measles, infectious hepatitis, or polio, the gamma globulin in his blood contains antibodies to fight those diseases.

Value of the serum as a modifier or preventive of measles has been known since World War II, and in 1944 the Red Cross began distribution of gamma globulin, processed from surplus plasma, to state health departments for this purpose. Subsequently, it was learned that gamma globulin was also effective in the treatment of infectious hepatitis. In 1951 and 1952 studies made at Provo, Utah, Houston, Texas, and Sioux City, Iowa—financed by the National Foundation for Infantile Paralysis and

(*continued on page 52*)

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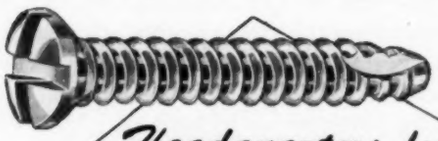

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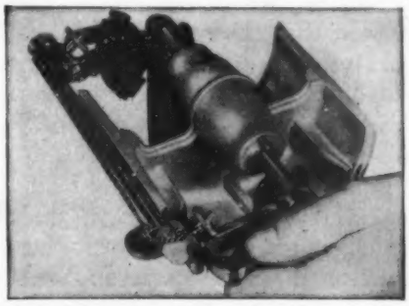

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To prepare isotonic saline solution 1:3300 for irrigation, hot soaks, compresses, etc.

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W&T WALLACE & TIERNAN PRODUCTS, INC., Belleville 9, N. J., U.S.A.

Outside the Ivory Tower

(*continued from page 50*)

directed by the University of Pittsburgh's Graduate School of Public Health—demonstrated that the serum would also prevent the paralytic effects of polio. The Red Cross provided, without charge, the gamma globulin (having a commercial value of $396,500) used in these studies.

Analysis of the polio field tests led to a meeting in Washington on November 19, 1952, at which representatives of the National Foundation for Infantile Paralysis, the National Research Council, the Department of Defense, the Federal Civil Defense Administration, the Office of Defense Mobilization, the National Institute of Health, the United States Public Health Service, and the American Red Cross discussed what could be done to make gamma globulin available for use in 1953. Two days later the Office of Defense Mobilization formally requested the Red Cross to undertake the project of supplying enough of the serum to meet the summer's minimal epidemic needs.

The Red Cross Board of Governors authorized the project on November 24, 1952, with the stipulation that the Red Cross would not be responsible for allocation and distribution of the gamma globulin. Three days later a plan was worked out with the Armed Services Medical Procurement Agency that provided double use for blood collected for defense purposes—its fractionation into serum albumin, the potent shock fighter being increasingly used by the armed forces, and into gamma globulin for polio.

To assure maximum use of the limited supply of gamma globulin available, allocation and distribution responsibility was accepted by the ODM.

On February 10, 1953, the Navy turned over to the Red Cross 460,000 grams of war surplus gamma globulin in dried form. The Red Cross is paying for the testing and packaging of this supply, which will provide 2,000,000 cc. for polio distribution. On February 25th the Red Cross turned over to the ODM 1,715,000 cc. of gamma globulin in 2 cc. vials. The Red Cross will provide additional quantities from current defense blood collections and salvage of outdated civilian blood.

On March 4th the ODM announced that a supply of gamma globulin for use against measles and infectious hepatitis would be allocated to state and territorial health officers. On March 13th the ODM announced that an additional allocation of gamma globulin would be made to state and territorial health officers for use against polio on an intimate contact basis. An additional quantity of gamma globulin would be available for use in epidemics and emergency situations. Criteria to assist in this distribution was to be established by the National Research Council or a special panel appointed for this purpose.

It is believed that this plan of allocation and distribution provides for the most economical and effective use of the available supply of gamma globulin and ensures that the serum will reach the largest possible number of children exposed to poliomyelitis.

From 1944 until the ODM began nation-wide distribution in January, 1953, the Red Cross distributed without cost 4,132,318 doses (2 cc.) of gamma globulin for measles and hepatitis.

A NEW scholarship in industrial arts has been given Western Michigan College by the Orthopedic Frame Company of Kalamazoo, it was announced by Dr. John Feirer, WMC, and Harry Treace, general manager of the company. Dr. Homer Stryker, Kalamazoo, orthopedic surgeon, is president of the company.

The scholarship, which will first be awarded to an entering freshman in the fall of 1953, will be placed on a trial basis for three years, with graduating seniors from all Michigan high schools eligible to compete. Successful students will receive $200 their first year in college and $100 each year thereafter, making a total of $500. Included in the award will be part-time employment with the Orthopedic Frame Company during the college year.

The aim of the company in making this award is "to stimulate interest in industrial arts and to help raise the caliber of industrial arts education." Students interested in applying for the scholarship should do so at once, writing the registrar of Western Michigan College.

THE president of Mutual of Omaha, V. J. Skutt, presented Dr. Howard A. Rusk, New York City physician, educator and writer, the Mutual of Omaha Dr. C. C. Criss Award, in Atlantic City, on April 16th. The Dr. Criss Award consists of a $10,000 cash prize, plus a

(*continued on page 54*)

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POTENT ANESTHESIA in Itching and Surface Pain

Via 20% Dissolved Benzocaine

A rapid control of surface pain in many post-surgical conditions: Hemorrhoidectomies, episiotomies, amputations, removal of tape. Also to prevent pain in rectal and other examinations and instrumentation. Available "Clear" and "With Chlorophyll."

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TOPICAL ANESTHETIC OINTMENT

Send for FREE SAMPLES

ARNAR-STONE LABORATORIES, INC.
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Jayne Bryant
SAFETY-CHECK BLANKET

COMFORT *plus* SAFETY FOR ALL CONCERNED!

The *Jayne Bryant* Safety-Check Blanket provides safety, comfort and more freedom of movement for confused, agitated, excitable or violent patients, either hospitalized or in home confinement. *Write for complete information.*

Jayne Bryant **SAFETY-CHECK BLANKET**
Dept. J.S., 7646 Vincennes Ave., Chicago 20, Ill.

***Dramatic New* SKIN PROTECTANT**
Containing for the First Time*—SILICONES
Adhesive—Moisture Repellent—Inert

To protect skin against maceration in colostomy drainage, ileostomy, cavernostomy, proctitis, diabetic gangrene, etc. Effective in many cases formerly failures under accepted therapy. Said to outmode zinc oxide ointment, aluminum pastes, calamine, etc.

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It is a positive aid in controlling the offensiveness of irrigation; allowing the patient to irrigate in the accepted manner, using a catheter of choice and inserting to desired depth.

The cover which is placed over the top of shield as soon as the catheter is withdrawn conceals all offensiveness and serves as a desk top Thus, the time necessary for patient to complete the irrigation can be devoted to some useful purpose, directing the patient's mind away from an unpleasant job.

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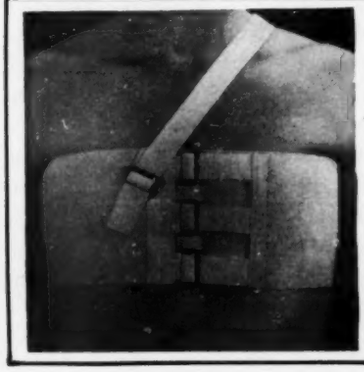

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LITTLE MFG. CO., BOX 202, WADESBORO, N.C.

Outside the Ivory Tower

(*continued from page 52*)

gold medal, and is presented annually as a reward for public-spirited men and women who have aided the cause of humanity. The presentation was made at the Annual Dinner of the American College of Physicians by Mr. Skutt. The previous winners of the Dr. Criss Award were Drs. Edward C. Kendall and Phillip S. Hench, of the Mayo Clinic, who received the award in 1951 for their development and use of cortisone.

A RECENT letter received reads as follows: "The Medical Committee of the President's Committee on Employment of the Physically Handicapped has embarked on a program aimed at familiarizing our medical colleagues with the basic facts and values of rehabilitation. As a member of this Committee, I am contacting all of the editors of the specialty journals in an effort to solicit their help in the publishing of papers relating to rehabilitation.

"Our desire is to have papers on rehabilitation appear in your Journal prepared by specialists in your discipline, who are either familiar with rehabilitation processes or are actively engaged in one phase or another of rehabilitation. One way in which this could be accomplished would be for you, as the Editor, to solicit a paper, or papers, on rehabilitation from those individuals known to you who have a facile pen and are identified with this field in your specialty. Or a group of specialists could be called upon to prepare a series of papers, each representing perhaps a single phase related to his particular contribution to rehabilitation.

"I would appreciate very much hearing from you as to the feasibility of this project and any suggestions, comments, or plans you might have in this connection would be extremely helpful, for this is the initial effort being made in publicizing rehabilitation exclusively among the members of the medical profession. The program could be aided further if a covering editorial were to appear at the time of the publication of the paper or papers.

"In advance, for your consideration in this, my many thanks."

Signed: J. S. Felton, M.D., Medical Director
Oak Ridge National Laboratory
Oak Ridge, Tenn.

THE American Heart Association and its affiliates have jointly awarded a total of $285,400 to fifty-one scientific investigators working toward the prevention and control of heart diseases, it was announced by Dr. Irving S. Wright, President of the American Heart Association. The awards are the first of this year's allocations from contributions made by the public during the 1952 Heart Fund campaign. They are in the form of fellowships and investigatorships awarded to individuals engaged in basic and applied scientific studies in the cardiovascular field to be conducted during the fiscal year beginning July 1, 1953. The research scientists will carry out their studies at institutions in twenty states and two will be conducted in London.

LUNG cancer now leads all other diseases of the respiratory tract as a cause of death among white men in the United States, taking a higher toll than either respiratory tuberculosis or pneumonia, Metropolitan Life Insurance Company statisticians report. The 1950–1951 death rate from respiratory cancer for males among the company's industrial policyholders was 25.7 per 100,000; the rate for respiratory tuberculosis 21.9 per 100,000, and that for pneumonia 14.6. The excess of the cancer rate over that for tuberculosis and pneumonia is most marked at the older ages.

A YALE surgeon reported that surgical shock, a leading cause of death on the operating table, now can be more effectively controlled with the help of drugs. Dr. Mark Hayes, Associate Professor of Surgery at the Yale School of Medicine, explained that surgical shock can be overcome in many cases by the prompt administration of an extract of the adrenal gland. Dr. Hayes, whose research is supported by the American Cancer Society, gave his report at a meeting of the American College of Surgeons. He said that there had been encouraging results of this treatment on several patients who suffered from shock during operations for cancer. All of the patients rallied immediately and death from shock was prevented. He based his clinical experiments on the observations of other scientists who found evidence that shock resulted from adrenal insufficiency.

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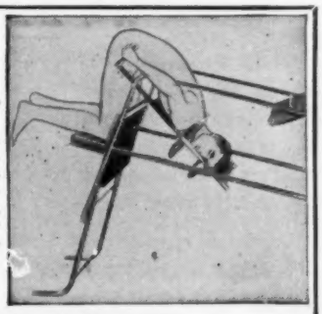

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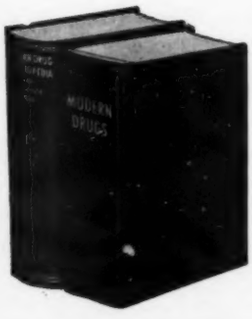

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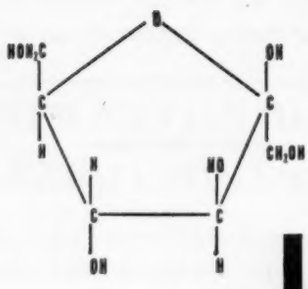

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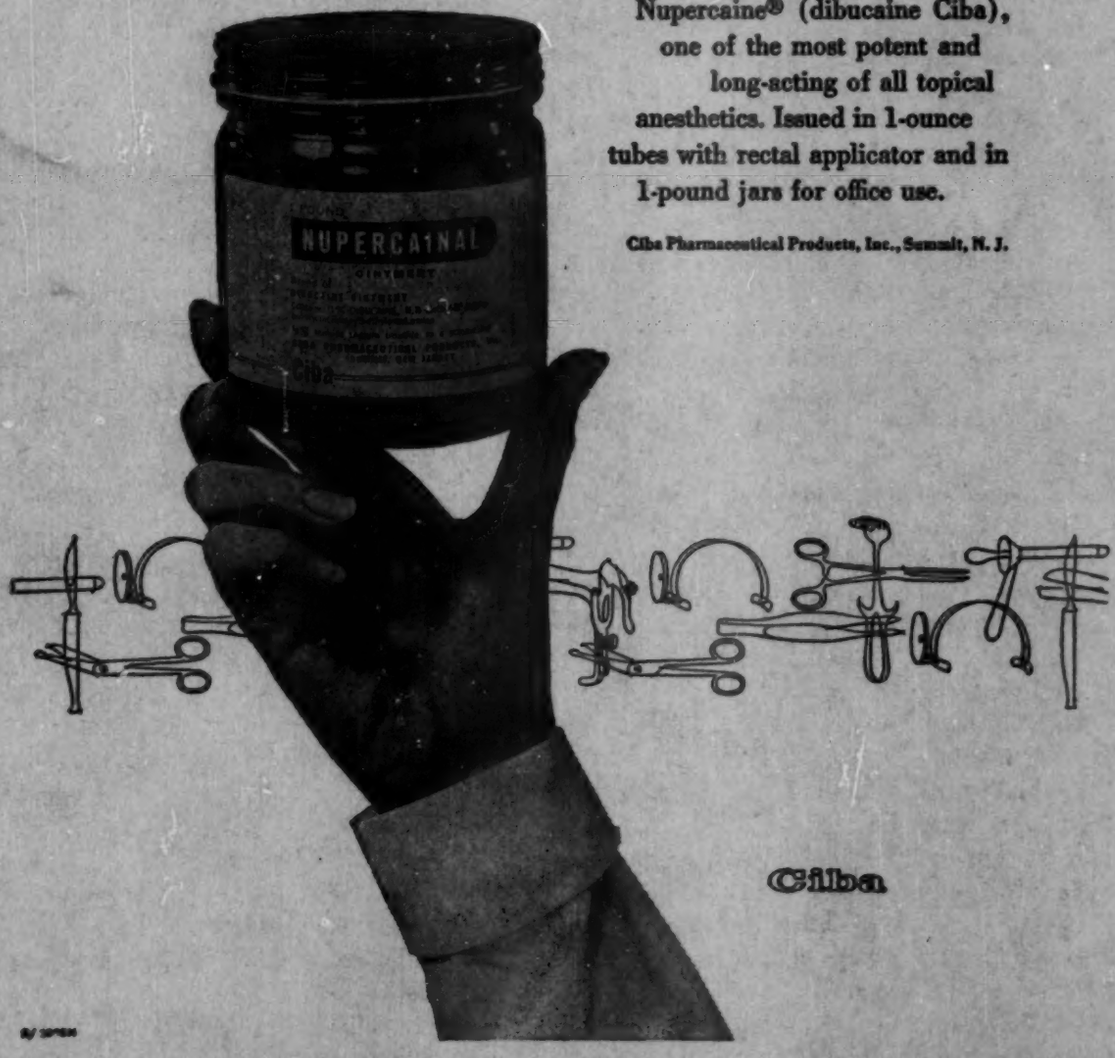

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